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Electrical World

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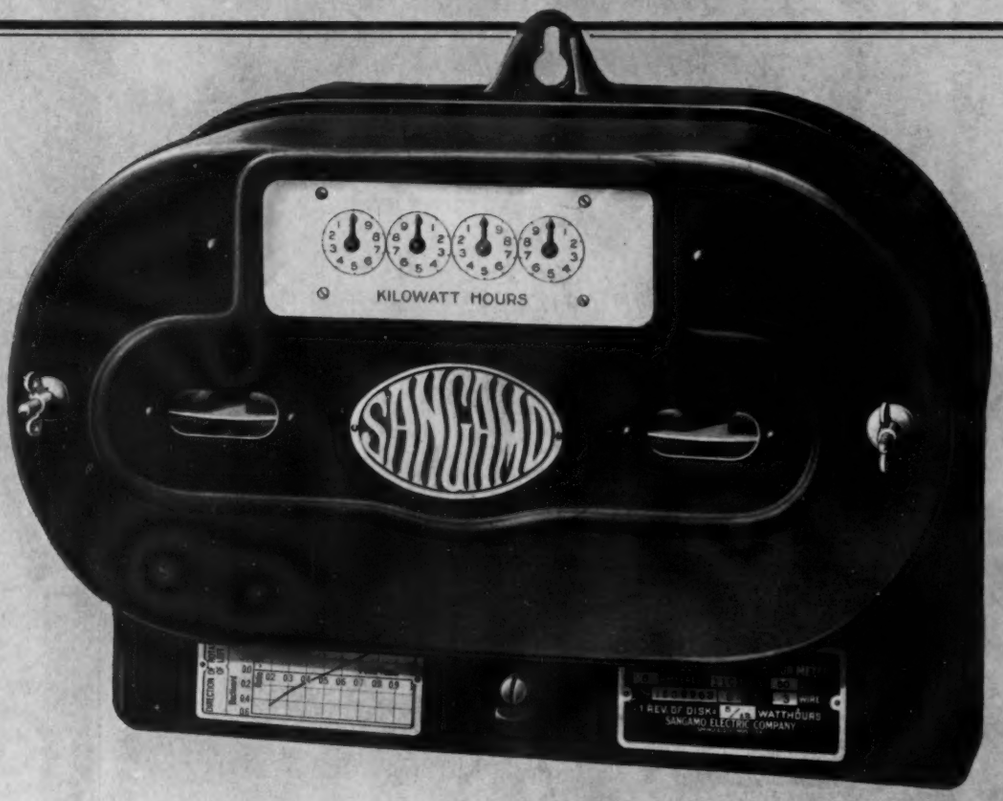

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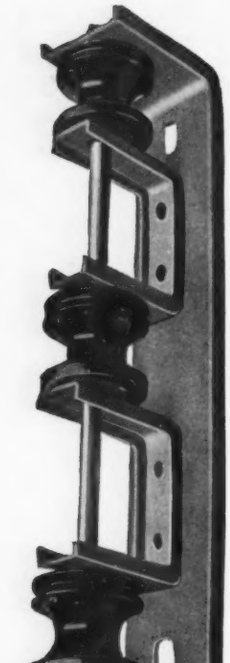

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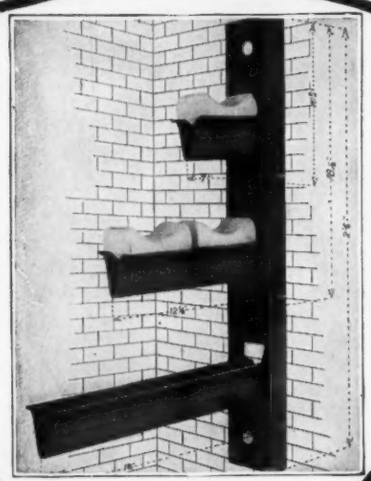

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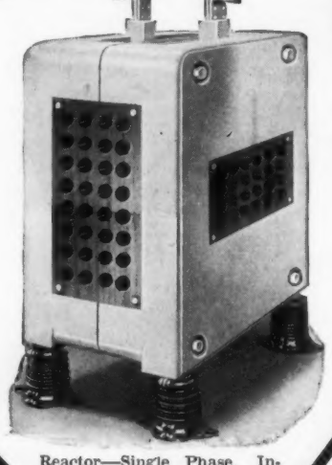

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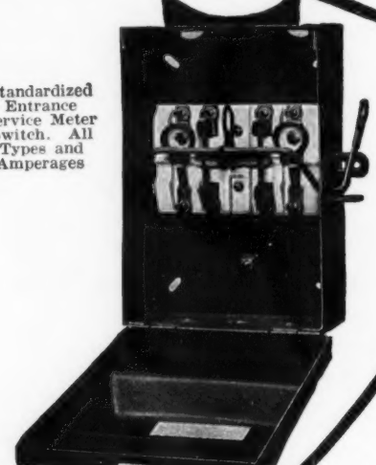

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Electrical World

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Electric Public Utilities Make Excellent Showing

NUMEROUS annual reports of electric public utilities appearing at this time tell tales of improved earnings and increased outputs which cannot but impress investors with the stability and efficiency of the industry. Increases in net earnings are attributable not so much to increased gross as to decreased operating expense. For example, the Detroit Edison Company, which has built an enviable record for itself during the past few years, reports an increase in gross earnings of 20.3 per cent, whereas the net earnings last year showed a gain of 57.9 per cent, a truly remarkable showing reflecting great credit on the operating staff and management. One of the surprises of the year, however, is furnished by the Georgia Light, Power & Railways, an association holding the securities of a number of utilities operating from Macon, Ga. A preliminary statement of earnings for 1923 shows an increase of 191.7 per cent in net, indicating that conditions in the old South are improving greatly. Utilities serving Cincinnati and vicinity also report enhanced earnings, the Columbia Gas & Electric Company showing an increase in net of more than 25 per cent, and thus it goes.

Were these earnings attributable to increases in rates, they might give the industry some concern. But, as a matter of fact, rates are either the same or lower than they have been in years, because of greater efficiency on the part of the industry. The public therefore has gained and will continue to gain in improved service at minimum cost, while the industry has not lost either money or prestige, but, on the contrary, has added to its record of service and stability. Hence its securities are becoming more and more attractive to investors. This means lower bond rates and assurance of ample capital with which to carry on.

The Coffin Medal an Encouragement to Performance

THE invitation which has gone forth to all central-station companies to make their entries for the 1924 Coffin medal should bring response from a large number. And, judging from the reports of 1923 operations now being made and published, the problem of selecting the 1924 medalist promises not to be an easy one. As mentioned in the preceding editorial, many companies are showing substantial gains over previous years, and these gains can be but reflections of greater service, of larger business better rendered. There should thus be candidates galore whose accomplishments in the past year will encourage them to seek the medal.

In an industry such as this, with success and progress recorded on all sides, it is indeed an honor to a company to be selected from among its fellows as having made the major contribution during the year. And the medal has more value than empty honor. It is fruitful of public good will from the home community of the medalist company. The sense of accomplishment felt by the organization is a spur and encouragement to future performance. The "by-products" to the winner are invaluable, too, as it was probably in the minds of the donors that they would prove to be.

But to only a slightly less degree do the other entrants share the benefits of the contest. No company can prepare a story of its accomplishments without at the same time uncovering to itself its own shortcomings. No executive can analyze his own department in the search for things well done without discovering some things not well done or not done at all. And the annual analysis on a basis of measurement other than financial serves as an additional means of indicating progress.

Quite naturally, no business is conducted for the purpose of winning medals. But a medal given on the basis of the Coffin medal definitely serves as an encouragement to performance.

Forty Years of Service an Honorable Record for the A. I. E. E.

FORTY years ago a small group of enthusiastic electrical engineers, imbued with foresight and courage and full of professional pride, gathered in Philadelphia and formed the American Institute of Electrical Engineers. A few days hence—on Monday evening, February 4—in this same City of Brotherly Love hallowed by Benjamin Franklin and other revered founders of the nation, the Institute will celebrate its fortieth birthday. These pioneers of 1884 created wisely and built well—in fact, better than they then could realize. Happily, many of them are still living to marvel at the great professional organization which stands as a monument to their work and which wields a worldwide influence for good. It has kept unsullied the splendid ideals of that early day, which were implied in the objects so felicitously enunciated—"the advancement of the theory and practice of electrical engineering and of the allied arts and sciences, and the maintenance of a high professional standing among its members, and the development of the individual engineer."

The influence of the Institute may well be measured in terms of men who have guided its destinies and contributed so greatly to the development of the art. Elihu Thomson, Edward Weston, Alexander Graham Bell, Frank Julian Sprague, Francis Bacon Crocker, John J. Carty, Charles P. Steinmetz, Henry G. Stott and Schuyler Skaats Wheeler, past-presidents of the Institute, will always be recorded among the men whose names signify engineering accomplishments of remarkable brilliancy. On the list of members living and dead are, besides, such honorable names as George Westinghouse, William Stanley, Charles F. Brush, Nikola Tesla, Benjamin G. Lamme, Elmer Sperry, Michael I. Pupin and Robert A. Millikan, not to allude to the thousands of others whose co-ordinated efforts have made possible

the present astounding achievements in the electrical industry.

The laurels of the Institute have been earned by its members, who have faithfully and brilliantly carried the light of electrical science into new realms. History cannot parallel the growth and accomplishments of the art of electrical engineering, and every member of the profession is proud and delighted to pay homage to the Institute as the technical body with which this wonderful and gratifying record is most closely entwined. The Institute symbolizes the profession and its ideals and receives the loyalty and devotion of all.

The entire electrical industry unites with the members of the Institute in this celebration of its fortieth birthday and wishes it even greater honor and success in its future efforts to bring a still more comprehensive realization of the objectives so well visioned and stated by the pioneers.

Popular Beliefs Versus Engineering Facts

THERE is a very real danger in the popular adoption of short-cut conclusions not founded on facts, and this is particularly true in engineering and economic situations of which the details are not understood by the public. "Superpower," for example, may mean "cheap power" to the public, while engineers may recognize it as "Interconnection dressed in a bridal veil for public admiration."

In much the same manner the desire and popular acclaim for whatever is thought to aid the conservation of national resources may result in loose talk about the conservation of coal through the use of distillation processes as a part of the business of electrical energy production. The assertion that the direct burning of coal for power purposes represents a vast waste of national wealth is misleading, if not entirely erroneous. That coal contains important and valuable ingredients which are destroyed is true, but unless all conditions are considered and all elements evaluated on an economic basis, this loss may be less than would occur should distillation be attempted. Only the surface of the technical and economic aspects of the subject has been scratched, but this fact may be obscured by broadcasting trite generalizations to the public. It is significant that the great amount of experimentation in Germany still results in conclusions such as indicated in the recent statement of Dr. Klingenberg that distillation is economically satisfactory in comparatively few instances. The same conclusions were reached in England after a very careful study had been made of its possibilities.

The production of fertilizer through the use of electricity is another topic that will bear a great deal of study before true statements can be made of its economic or even practicable engineering possibilities as an industry in this country. Admittedly, nitrates can be made by one or any of several processes that utilize electricity, but accurate cost and engineering data on commercial installations are very few in Europe and almost non-existent in this country. Moreover, a competitive condition exists with Chilean and even Scandinavian nitrates, so that there are very definite economic limitations for artificial nitrate production. A fact also frequently forgotten is that the proper utilization of nitrates calls for the use of potash and phosphoric acid also, and these chemicals must be made available as part of the economic combination before commercial success can be attained.

There is no cause for pessimism about the public's misinterpretation in connection with any of these developments; the near future should give definite data and actual operating experience of a character to determine the economic and engineering status of all of them. But engineers can safeguard healthy developments by stating the facts to the public and by continuing to apply their fundamental principle that results should be announced after the fact not before.

The Residence Survey Should Furnish Needed Facts

WITH all the progress that has been made in the development and the sale of electrical household appliances in the United States it still remains a fact that the electrical industry is operating with very little close-up knowledge of the condition of its market. There are approximate statistics on the number of wired and unwired homes in the country and the total load on central-station lines, and there is a small amount of other general information. But there—or thereabouts—information of this kind ends.

It is only in a few exceptional cases that there is any real basis of knowing how many appliances have been sold into the homes of any specific city and there is no satisfactory basis at all to tell how many have been sold in the entire country. No one has any definite data on what proportion of the appliances that have been sold are in use, or why some are not used, or which appliances are bought first or fourth in any certain type of home. In other words, the electrical man today is thinking of his market almost entirely in mass terms and in general terms. He figures that ten thousand homes, for instance, should buy a great many appliances, but all his planning is based on indefinite averages. He has no certain knowledge of his market.

The plans for a residence survey which are now being formulated by the National Electric Light Association are therefore of keen interest and vital importance to the entire industry. While the central station is the most intimately concerned, yet it is a matter of no less importance to the other members of the industry. For, as has previously been pointed out, three things come out of such a survey: First, a great benefit to public relations from the intimate personal contact with the community; second, accurate statistics on the local market, and, third, a large demand for additional appliances induced by the interest that is created. The dealer, the jobber and the manufacturer all will share in the enjoyment of this increased business. The facts which the survey develops will be quite as illuminating to them as to the central station. The improved public sentiment will react for them as well. For there is a community of interests in the electrical industry.

Any one of these three objectives is well worth the effort. The betterment of public relations will naturally have the strongest appeal to the central-station executive, but the value of the new knowledge of the market which this survey will produce must not be underestimated. For the first time the industry will have facts. It will know what households buy and why, and how much they will spend for electric service. It will know what they use and what they abandon after the novelty wears off—and the why of that. The survey will produce the first clear-cut picture of both the national and the local market for electrical appliances in America. It will bring to all classes of electrical men new opportunity of immediate worth.

Imperative Need of Controlling the Colorado River

IN A FEW weeks there will be hearings in Washington before congressional committees on the Colorado River. Diverse interests are involved—political, manufacturing, irrigation, power and others—and any permanent solution is bound to disappoint some of these interests and take considerable time. Meanwhile the floods of the Colorado continue to be a constant menace to the lowlands of Arizona, California and Mexico, and the immediate problem is how to control them quickly and effectively. In all of the Colorado River proposals before the Federal Power Commission the element of flood control is considered, but none of these is likely of execution until the seven-state treaty becomes effective, and all will require very heavy expenditures of money and considerable time for the erection of dams. This is not very consoling, however, to the inhabitants of the Imperial Valley, for instance, who live in constant dread of the destruction of their homes and property. A recent survey of the Arizona Engineering Commission, which considered the flood menace in the Imperial Valley in California and Mexico, discovered a dam site in the Mohave Canyon not far from Topock where it is possible to erect within two years and at very moderate cost a comparatively low dam which would be very efficacious in removing the flood menace in the Colorado River. The best interests of all residing in the Colorado River Basin would be served by the speedy erection of this dam, which, while it involves no power, will give flood protection and enable the power problems involved to be thrashed out carefully and in detail on their respective merits.

Technical Problems of High-Voltage, Long-Distance, Bulk-Power Transmission

IN ORDER to obtain the best economic balance when transmitting heavy loads for long distances at high voltage, studies show that the capacity in synchronous condensers required is approximately equal in magnitude to the amount of load transmitted. The exact location of this synchronous equipment depends on many factors. Sometimes locations along the line give the best solution, sometimes location at the load end is better. In any event, this equipment gives control of power factor, and this is the chief factor in the control of voltage and efficiency on these long high-voltage, bulk-power lines. Thus for good and reliable operation it is imperative that the system operator have control of power factor at each point on the system where synchronous equipment is installed, and this control should function as an independent element for each location.

In addition, it becomes necessary to devise means for synchronizing at different locations along the line and for holding equipment in synchronism when open circuits or short circuits occur. With synchronous condensers combined with reactive equipment carrying energy loads, serious phase differences will result in current interchanges of considerable magnitude if synchronizing is not done properly. But far more serious problems are encountered in attempting to hold equipment in synchronism when abnormal conditions occur. For these long lines are limited in load transmitted and are heavily reactive, and it thus becomes very difficult for synchronous equipment at the two ends to respond instantly, and in the same degree, to system disturbances. The use of high-tension switching will be very largely governed by the possibilities for holding equipment in synchronism during switching operations. It may be necessary for this and other reasons to connect rigidly both the generating and the load end of the lines.

These points are brought out to show that there are yet many practical technical problems connected with bulk-power transmission which call for intensive research and study to insure reliable operation under even normal conditions. It is encouraging to note that papers of interest along these lines are to be presented at the midwinter convention of the A. I. E. E. A careful study of the papers prepared by Percy Thomas and by R. D. Evans and H. K. Sells, which are published in the January *Journal of the A. I. E. E.*, is warranted, since they record great strides in the art, although they differ somewhat in their conclusions as to the practical applications of the principles involved.

Electrification of Farms in Sweden

THE proper electrification of rural districts requires the co-operation of the majority of the farmers, and there is need also for a thorough investigation to determine the best system of distribution. These are two important conclusions drawn by Torsten Holmgren in an article elsewhere in this issue on the experiences of Sweden in the electrification of farms. The methods of distribution in Sweden, particularly in the number of voltages used, are about as diverse as will be found in the United States. Co-operative societies have experimented with flat rates for energy and are now developing a preference for the fixed-demand charge with the lowest possible energy rate as a means of stimulating consumption and developing a high load factor. The same difficulty with equipment that has appeared in America appears in Sweden.

The solution of the rate problem and the bringing of service to the entire population in a given district lie in the hands of the central-station industry of this country, because conditions are such that any company should be in position to handle the entire territory in which it operates. The governing circumstances also make it possible to handle the distribution problem in the most economical way by fitting the systems into the generating and transmission systems already in existence. The farm organization which buys energy on a wholesale basis and retails it to its own members has been tried here and found wanting, because such organizations automatically become public utility corporations under the method of regulating the central-station industry, though as a matter of fact they have neither the viewpoint nor the organization to make success a possibility. Unless they develop uneconomical duplicates of existing organizations, the factors needed to insure success are impossible of attainment.

The Swedish experience as detailed by Mr. Holmgren is interesting because it closely resembles our own and emphasizes again the need of enlisting the hearty co-operation of agricultural and electrical industries in the study of rural electrification. The electrical industry must handle the electrical distribution and equipment questions. Fortunately, in addition to the talent available in the electrical industry, the technical and practical talent in the agricultural industry is already busy on the agricultural problems and the co-operation between the two industries is already organized in the United States on a broad basis.

Mammoth Hydro-Electric Unit at Niagara Falls, N. Y.

THE largest hydro-electric unit at present in existence is located at Niagara Falls, N. Y. The turbo-generator set saves the equivalent of 700,000 tons of coal a year, in addition to the labor and investment necessary in its mining and transportation, and sets the record for low labor cost per unit of energy generated.

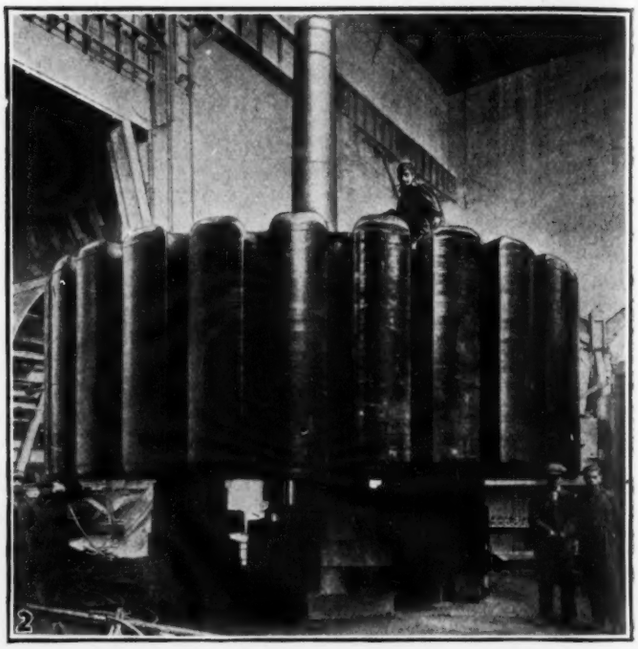
No. 1—Section through 70,000-hp. turbine and Johnson valve.

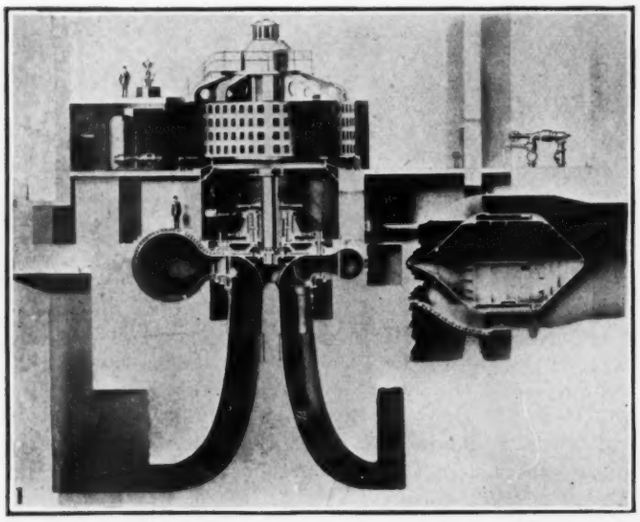
No. 2—Mammoth rotor of the 65,000-kva. unit.

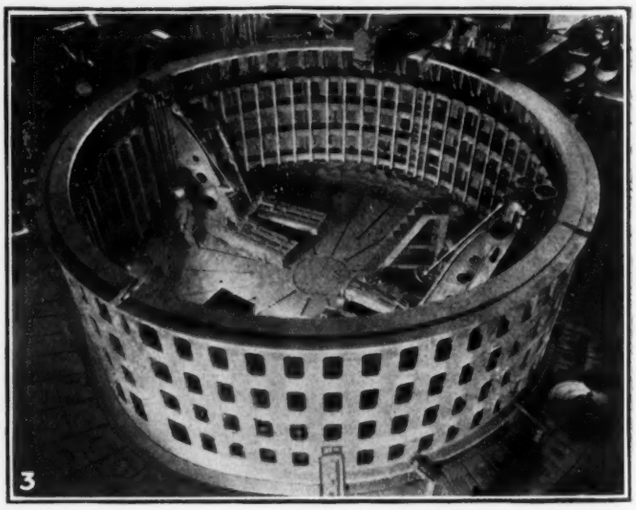
No. 3—Stator of 65,000-kva. unit in the machine shop.

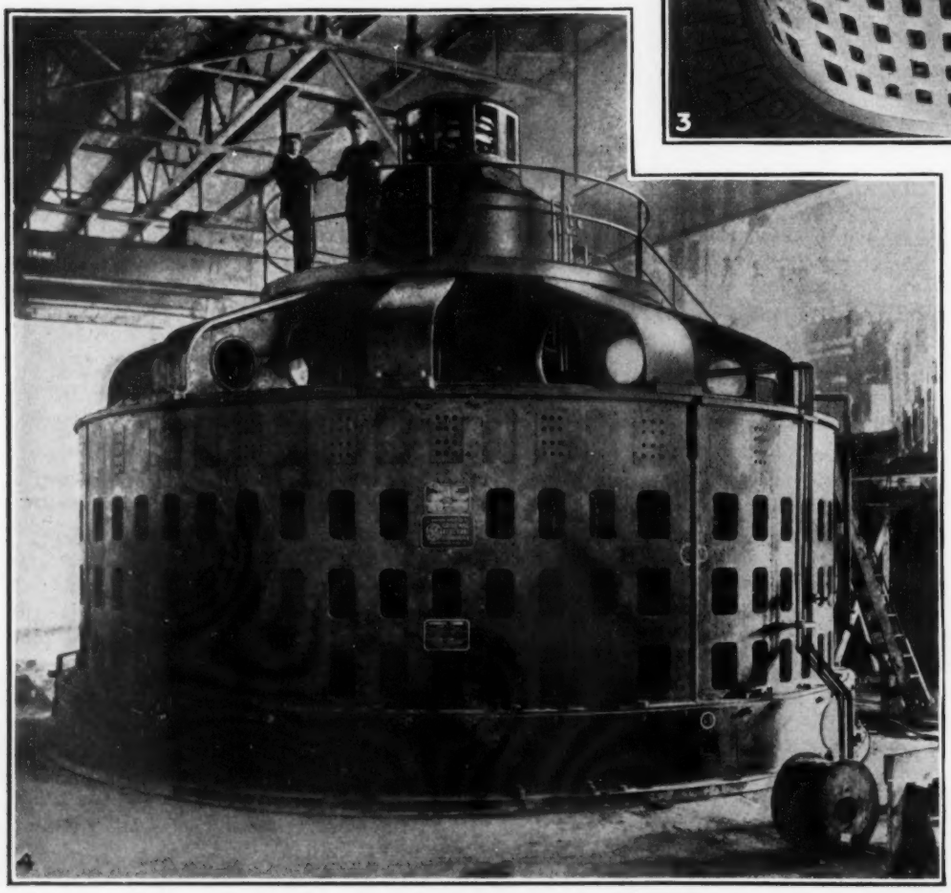
No. 4—Assembled 65,000-kva. generator.

No. 5—An armature coil of the 65,000-kva., 12,000-volt generator.









World's Largest Hydro Unit

Niagara Falls Power Company's New Turbo-Generator Has Interesting Design Features—Weight of Machine Is 1,500,000 Lb.—Careful Design Was Required to Enable It to Withstand Rotational Stresses

By M. C. OLSON and E. B. PLENGE
General Electric Company

JACOB F. SCHOELLKOPF of the Niagara Falls Power Company, standing before a distinguished assemblage of engineers and executives in the power house of the company at Niagara Falls, recently started the world's largest hydro-electric unit. This unit is rated at 65,000 kva. and is one of three now on order by the company which are all expected to be in operation by the summer of 1924. The unit now in operation is driven by a 70,000-hp. hydraulic turbine under an effective head of 213.5 ft. The Johnson valve for controlling the water supply to the unit is 21 ft. x 14 ft. and is the largest yet built. The accompanying illustrations show different views of the unit and the arrangement of the equipment viewed in connection with its operation.

The generators are rated at 65,000 kva. with ratings of 52,000 kw. at 80 per cent power factor, 12,000 volts, 25 cycles, 28 poles and 107 r.p.m. They have a guaranteed efficiency of 98.1 per cent at 65,000 kva. unity power factor, 97.8 per cent at 90 per cent power factor and 97.5 per cent at 80 per cent power factor. At 65,000 kva., 80 per cent power factor, continuous operation, the temperature rise on the stator will not exceed 50 deg. C. by thermometer and 60 deg. C. by embedded-resistance temperature detector. The guarantee on the rotor is 55 deg. C. by resistance. The generator will operate at 5 per cent in excess of the rated output of 65,000 kva. at any power factor not lower than 80 per cent and at any voltage between 12,000 and 13,200 without exceeding the safe operating temperature of the insulation provided the ambient temperature does not exceed 35 deg.

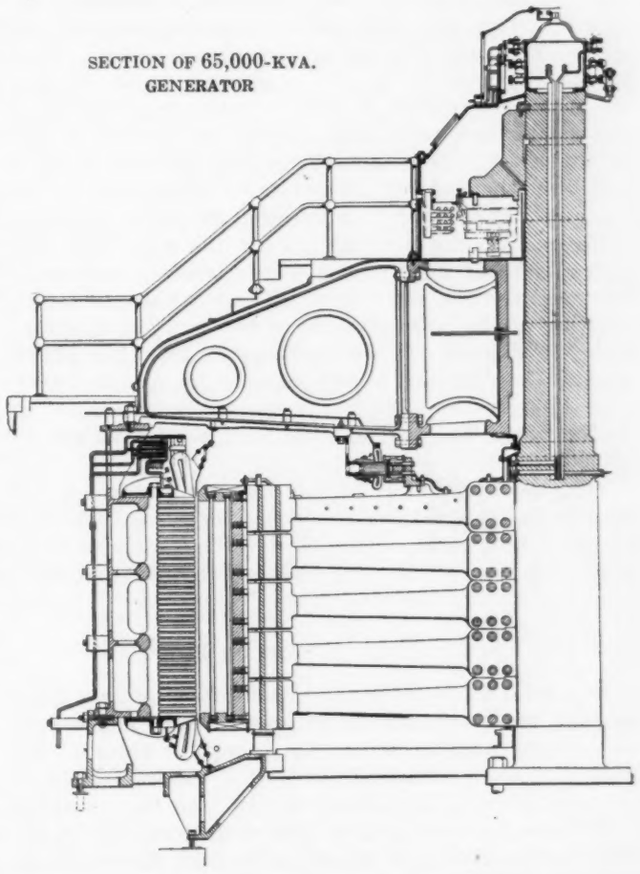
There are twenty-four resistance temperature detectors in the stator for indicating the temperature of the armature windings. Some of these are inserted between the coils in the slot and some are at the bottom of the slot.

A 650-kva., three-phase, 2,200-volt excitation generator is mounted between the rotor spider and the upper bearing bracket of the machine. This 650-kva. generator supplies energy for the motor-generator sets and furnishes the direct-current excitation for these 65,000-kva. machines. It also furnishes energy for operating blowers and pumps.

The illustrations show the general construction of the outside and the inside of the rotor and of the stator frame of the large unit before assembly and the assembled stator as it looked in the process of machining at the factory. Each section has a gross weight of approximately 42,600 lb., and the outside diameter of the stator is 30 ft. 4 in. with a height of 10 ft.

The stator punchings are held in place by keys attached to the stator ribs. The punchings are firmly clamped between very rugged cast-steel flanges and the top and bottom of the stator by means of 120 steel studs, 2½ in. in diameter. On account of the weight of the machine the punchings were assembled at the power station and jacks were used for pressing at very frequent intervals so as to obtain a tight core, the length of which in this unit is 7½ ft.

The stator frame is supported on a continuous cast-iron-base ring which weighs approximately 53,000 lb. and was machined by two revolving planers. The base is partly embedded in concrete at the power station.



SECTION OF 65,000-KVA. GENERATOR

In the base are twenty-four bolts for centering the stator frame, and in addition to these 2½-in. holding-down bolts there are twenty-four 1½-in. radial dowels to prevent any movement between stator and base under the most severe conditions of short circuit.

The armature coils in the machine are 10 ft. 7 in. long and approximately 25 in. in width, and each coil with its insulation weighs about 200 lb. The insulation is of mica, each turn also being insulated with mica tape. At the end, at the top and bottom, the armature coils are laced to two steel supporting bands to prevent any distortion of the winding due to short circuits.

The upper bearing bracket consists of a cast-steel central hub 10 ft. in diameter and 6 ft. 4½ in. high,

having a weight of 42,000 lb. To the hub are bolted ten cast-steel arms with heavy central ribs, each arm weighing 7,800 lb. These arms have a projection at the upper end which fits in a rabbet in the central hub. When the structure is finally bolted together and machined, dowels are used to relocate the arms in their proper position when assembling at destination. In order to avoid the possibility of oil leakage through porous spots which might occur in the bearing bracket casting, a steel plate 1 in. thick is provided to form the bottom of the thrust-bearing oil wells. The bolts for attaching the plate to the bracket are placed outside the housing so there can be no leakage around them. Steel lugs are welded to the under side of the plate at the points where the dowel pins for the thrust bearings pass through it. The assembled bracket has a total weight of 120,000 lb. and must support the generator rotor, excitation generator, waterwheel and hydraulic thrust, the total weight of which amounts to approximately 1,143,000 lb.

The thrust-bearing housing and brush rigging and collector rings are designed with special reference to accessibility and convenience of disassembling. The outside diameter of the collector rings is 38 in., and the excitation current is carried to the main generator and exciter generator field by busbars through a hole in the shaft. The support for the collector ring is bolted to the end of the generator shaft, and at the top of the generator a speed-limit switch is mounted.

Because of the unusual size of the rotor the field spider is made up of five separate wheels, each wheel being split. The two halves of each wheel are bolted together at the hub by means of twelve 3½-in.-diameter nickel-steel studs. These studs are heated when put in place. The rims are joined together by special nickel-steel links, which also are heated when assembled at destination. The ten sections have a total weight of 380,000 lb.

With each section of casting there is attached a test coupon for determining the character of the material entering into each casting, and tests were also made upon test pieces from the nickel-steel links that were used for joining the steel rims.

Speed Specifications on Rotor

The rotor is designed for an overspeed of two times normal, but on account of its great height and weight it was not feasible to test the completed rotor at the factory. Each wheel of the rotor, however, received an overspeed of two times normal for two minutes, which is considered a more searching test than if the whole rotor had been tested, since each wheel had to withstand by itself the proportional strain imposed upon it.

The shaft of this generator has a diameter at bore of field spider of 34 in., and the diameter of the forged coupling is 59 in. The coupling bolts that connect the generator shaft to the waterwheel shaft consist of eighteen 4½-in.-diameter bolts, and the holes are reamed to exact size at destination.

Each pole is attached to the rotor rim by means of twenty 2¼-in.-diameter bolts. The bolt punchings are clamped together by means of through bolts, and the assembled pole piece has a copper-strip field winding. Each turn of this field winding is 0.43 in. thick, and the approximate width of each coil is 21 in. and length 8 ft. 4 in. To hold this immense weight of copper in place at the overspeed a coil bracket is placed between the poles at the center of the field coil. These heavy field coils are heated and clamped to size.

Brakes Are Used for Stopping Unit

Twelve air-operated brakes are mounted on a very rigid continuous supporting ring embedded in the concrete. These brakes will operate at a pressure of approximately 100 lb. to 125 lb. per square inch and will stop the rotor having a WR^2 of 65,000,000 in approximately five minutes. The brakes are designed as a combination of brakes and jacks, so that in dismantling the generator the entire weight of the generator rotor and waterwheel can be supported on the jacks. The brakes when used for lifting purposes are operated by a Watson-Stillman high-pressure hand-operated oil pump with a pressure of approximately 1,500 lb. per square inch. All the piping for the combination brakes and jacks is extra heavy to withstand this pressure. A control valve for the brakes is conveniently located on the operating gallery.

The unit is equipped with its individual oiling system, consisting of a motor-operated oil pump and Richardson-Phœnix oil filters. Provision is also made for supplying oil from the station oiling system.

The induction motor is rated at ¼ hp., three-phase, 220 volts, 25 cycles and 750 r.p.m. The pump furnishes the required amount of oil for the guide bearings and in addition a small flow for the thrust bearing in order that it may be kept clean. Heat from the thrust bearings is removed by means of water circulated through copper cooling coils. Approximately 50 gal. of water per minute are required, and recording thermometers indicate the temperature of the oil in the thrust bearing and the temperature of that in the guide bearing. Air for ventilating the generator is taken in at the top and from the pit underneath the machine in about equal quantities and discharged into a housing surrounding the machine. Approximately 125,000 cu.ft. of air per minute is required for proper ventilation, and an exhaust fan is provided to insure the proper flow of air under all weather conditions. A novel feature for stopping the swirling air at the heads of the machines (due to the throwing off of the air from the rotor) and for insuring a change of air is specially designed vanes made of bakelite canvas. These vanes are made in short sections and attached at top and bottom of machine near the stator coils. Another advantage of these vanes is that in case of fire they tend to confine it to the immediate location.

The stator of the generator that is used for excitation is supported just beneath the upper bearing bracket. The rotor is mounted on the upper section of the steel spider arms of the 65,000-kva. machine. The 650-kva. generator at 80 per cent power factor continuous operation is rated at 50 deg. C. rise by thermometer on the stator and 55 deg. C. rise by resistance detector. There are six resistance detectors in the stator winding for indicating the temperature. The temperature guarantee on the rotor is 55 deg. C. by resistance. The armature coils have more than the usual thickness of insulation for this voltage. The generator is so designed that the poles may be removed between the arms of the upper-bearing spider of the main generator, and with this arrangement it is possible to replace armature coils of the excitation generator by removing a sufficient number of poles without dismantling any of the parts of the main

generator with the exception of the covers between two of the arms of the bearing brackets.

The total approximate weight of the unit now installed is 1,500,000 lb., and the outside diameter of the base ring on the machine is 31 ft. 10 in., with a total height from the floor line to the top of the generator of 26 ft. 4½ in. The generator on this unit was made by the General Electric Company and the Johnson valve and waterwheel by the I. P. Morris Department of the William Cramp & Sons Ship & Engine Building Company. A similar unit is on order from these companies, and another unit is on order from the Allis-Chalmers Manufacturing Company.

Experiments with Electrically Operated Barges in England

ACCORDING to the Birmingham *Post*, an experiment carried out by the Shropshire, Worcestershire & Staffordshire Electric Power Company in the use of electric barges at Kidderminster, England, has been successful. An ordinary canal barge rated at 25 tons nominal load is equipped with an electrical device which propels it at the rate of 3½ miles an hour when only half the power is used. As a further test the barge has been purposely beached on mud banks at this speed, and it was found that the boat could be pulled off again by exerting the full 18 hp. of the motor. For some distance along the canal experimental trolley wires have been installed, and from these electric power is derived for the operation of the propelling machinery. The driving plant is described as a simple arrangement, consisting of a hydraulic jet propulsion pump operating centrifugally. The inlet branch for the pump projects slightly below the bottom of the barge and is fitted with a number of guide blades which, when the whole of the propelling unit is rotated by the steerer, serve as a means of clearing away any weeds which may become entangled at the inlet. The outlet from the pump is what actually propels the barge, which is steered by jets of water from the pump. Among the advantages claimed for this arrangement is that it can easily be moved from one boat to another, as it is fixed in a cylindrical casing and can be lifted out as desired.

While it is realized that jet propulsion is not highly efficient, it is considered, nevertheless, that this method has many advantages. It is effective where unusual maneuvering facilities and freedom from the possibility of fouling are essential. It is stated that a barge equipped with a jet propulsion pump can be driven ahead, astern or sideways with one movement of the hand, and the reversal of the jet acts as a powerful brake in preventing collisions. No engine room is necessary, and additional space is therefore available for cargo, the total weight of the power unit being only 2,400 lb. While there is some expense, particularly in the installation of the overhead lines, it is claimed that with the elimination of towpaths and decreased cost of labor and other considerations the new method would be very economical and has quite a wide field of application where energy is available adjacent to barge-using canals.

Electric Power Production by Central Stations a Business Indicator

SOME very interesting studies of electric power production by central stations as a business indicator have just been completed by A. H. Horton, chief of the Power Resources Branch of the United States Geological Survey, the results of which appear in the accompanying diagrams. Diagram 1 compares the average daily production of electrical energy with the value of manufactures and the "index curve of trade" constructed by the Harvard Committee on Economic Research. Fig. 2 shows the normal seasonal variation of electric power production, the decreased consumption of electrical energy during the summer months being due in a very great measure to the decreased lighting requirements.

Commenting on the sensitiveness and value of a business barometer based on electric power production, George Otis Smith, director of the United States Geological Survey, says: "In the first place, electric power faithfully reflects all business and the percentage of it which is used for lighting gives a not disproportionate weight to its domestic use. The curve is nowhere distorted by storage. The production of power is simultaneous with its consumption, and the production curve is actually a consumption curve. Furthermore, the curve is not affected by ordinary strikes and external factors such as car supply, except when interruption in the receipt of fuel may continue long enough to exhaust the supply of stored coal and thus force the plant to curtail output."

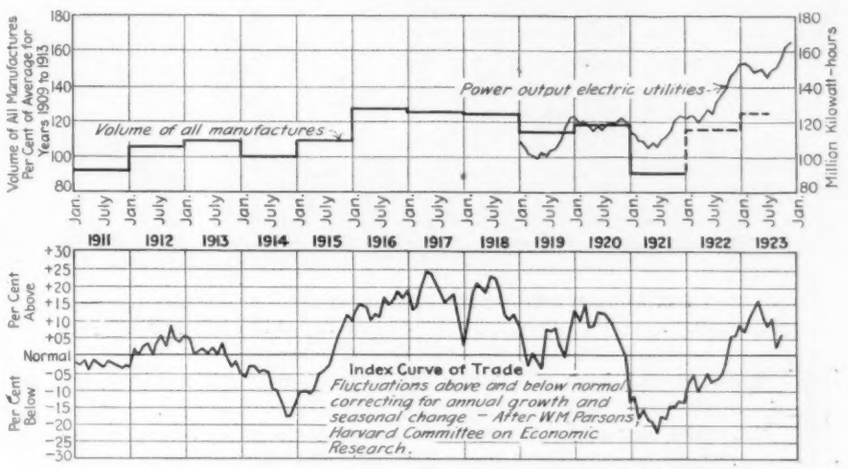

Volume of All Manufactures Per Cent of Average for Years 1909 to 1913
Million Kilowatt-hours
Power output electric utilities
Volume of all manufactures
1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
Per Cent Above
Normal
Per Cent Below
Index Curve of Trade
Fluctuations above and below normal correcting for annual growth and seasonal change - After WM Parsons Harvard Committee on Economic Research.

FIG. 1—PRODUCTION OF ELECTRICAL ENERGY FOLLOWS THE TREND OF GENERAL BUSINESS VERY CLOSELY

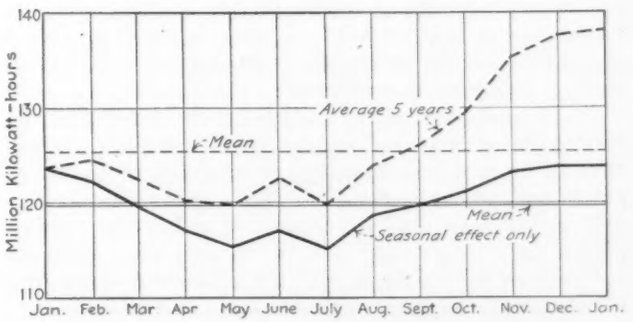


FIG. 2—NORMAL SEASONAL VARIATION OF ELECTRIC POWER PRODUCTION

Electrification of Farms in Sweden

Most Economical System of Distribution Found to Be Dependent on Density of Population—Formation of Farmers' Organizations and Details of Equipment Best Suited to Farmers' Needs

By TORSTEN HOLMGREN
Consulting Engineer, Stockholm

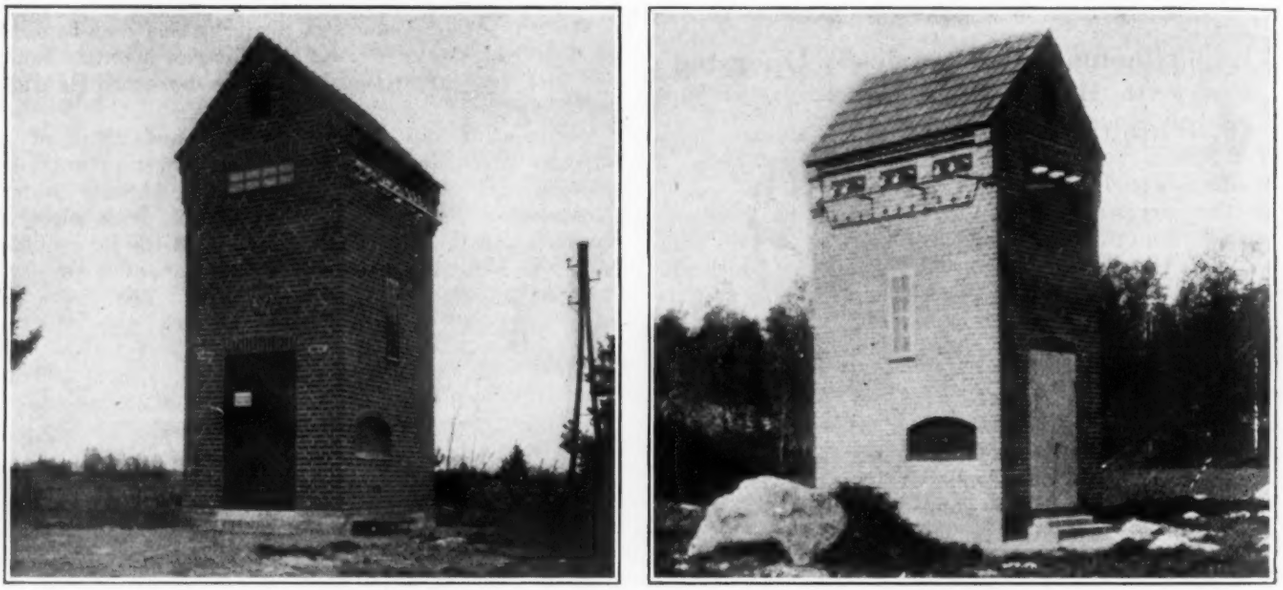


FIG. 1—SUBSTATIONS IN RURAL DISTRICTS. FUSES ARE ACCESSIBLE FROM OUTSIDE TO THOSE HAVING KEYS TO UNLOCK THE SHUTTERS

FOR MANY hundred years the main industries in Sweden, like those in other countries, were located along the banks of rivers and streams, because waterwheels were the only sources of power. In the first part of the last century the steam engine brought with it the possibility of erecting industrial plants anywhere, and from that time there has been a rapid growth in the population of Swedish towns possessing no water power, a striking testimony to a prospering industrial evolution, dependent for the most part on imported British coal.

Forty years ago with the advent of the Edison incandescent electric lamp came the erection of electric generating stations at most of the old water-driven plants, and the next step—one that a great many steam-driven factories also took—was to substitute electric motors for the old shaft and belt transmission systems. As soon as the electrical art had solved the problem of transmission the rural factories one after another took advantage of water powers in their neighborhood and used them for their own expansion.

The earlier three-phase transmission lines—the first of which is not quite thirty years old—were commonly built to concentrate power from several waterfalls in a growing industrial settlement. In the last decade of the past century and the beginning of this nearly all the cities and towns of Sweden, nearly one hundred in number, erected electric central stations, most of them at first driven by steam or oil engines. This development gave rise to several undertakings whose first purpose it was to transmit water power to one or more cities where central power stations and large factories were consuming expensive imported fuel. Thus arose the distributing networks that now carry power from large water-power stations to many customers in the cities and along the railroads. These undertakings are joint-stock companies with the exception of the extensive plants of the government at Trollhättan, Alvkarleby and other places, which utilize some of the most valuable water-power sites in the country.

With the great increase in transmission voltage and the other improvements in the electrical art, interconnection of power plants has been carried out on a large scale, and the power situation in Sweden is now the same as in most other countries where water power abounds; that is to say, the outlines of a superpower system designed to utilize distant water powers for the common benefit, especially of those parts of the country where the density of population emphasizes the need of power, are now to be seen. Whether such a scheme will be carried out by the government as a virtual monopoly or by some kind of a company with the government and municipalities as stockholders has not yet been publicly discussed. It has, however, been decided that the electrification of the government railroads, which is now going on, shall include as a basic principle the distribution of power from the government transmission lines to other consumers.

The large power undertakings, of course, have been forced by economic considerations to pick up a load for

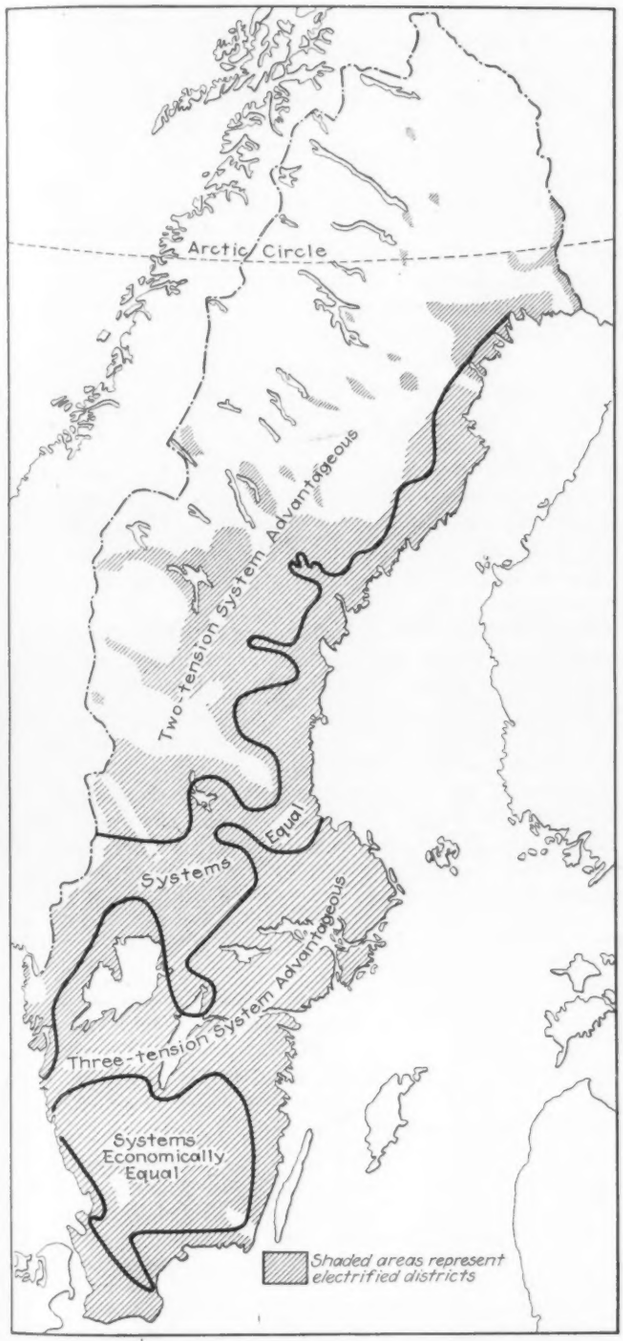


FIG. 2—ELECTRIFIED DISTRICTS OF SWEDEN, SHOWING MOST ECONOMICAL SYSTEM OF DISTRIBUTION FOR EACH ZONE

new power houses wherever they could get it on acceptable terms. As long ago as fifteen years the possibility of power distribution in farming districts was seriously investigated, and it was generally recognized that a general participation of the farms would be essential to the project. Experience in the field had been already gained by the country factories, which commonly run big farms of their own and had electrified them at an early stage, and by large farms situated on the route of industrial transmission lines of medium voltage.

However possible it might be to sell power from existing lines to large farms in their immediate vicinity, it was very difficult to establish among the vast majority of farmers the co-operation necessary for economical distribution over a considerable area, and it was not until Swden's supply of liquid fuel, all of which is imported, was cut off during the war and the lack of it forced the farmers to find a means of getting light and power without petroleum and gasoline that rural distribution became an urgent matter. During the years 1917-1918, when trade with America was stopped and neither fuel for oil motors nor copper for electric wires was to be had, the electrification of the bulk of the agricultural districts had to take place. At the end of the year 1921 more than 38 per cent of the arable land was "electrified," in the sense that will be explained later and at a cost of between 1½ and 2 per cent of the whole national fortune.

RURAL ORGANIZATION

Different companies have managed this business along different lines. Some of them at first adopted the methods used for city distribution and tried to deliver energy for light and power at flat rates at the customer's premises. On account of the high first cost of the distributing plants and the comparatively low load factor the resulting rates per kilowatt-hour were high and did not even stimulate consumption. The next step was to make the expansion of the network dependent on the financial co-operation of the prospective customers, to stipulate for contributions to the first cost in the shape of wooden poles, labor, teams, and so on, and to fix a minimum charge per hectare of the customer's cultivated ground.

Other power companies with less interest in the development of rural distribution sold the power for a fixed area at a substation to a local company without any conditions as to the terms to be made to customers. Experience soon proved this method little suited to promote prosperous rural electrification. The economical interest of the local company limited the distribution to the most profitable applicants. To get power other would-be consumers had to constitute a new company and buy energy from the first one. There are still districts where the power thus passes through three hands between the original power company and the farmer—to the disadvantage of the latter as regards both voltage regulation and price.

The government plants have chosen a middle way between those just mentioned. A thorough investigation of the farmer's needs, of the possibility of cutting down the total cost of energy and of means to raise the money for local distributing networks has led to a plan that is now being adopted in large parts of the country. This method aims at the forming of local joint-interest unions among the farmers, under the terms of special legislation, one union embracing an area with a radius of about four miles. Within this area the union is entitled and bound to distribute energy to anybody who wants it and pays for it at a uniform price approved by the central-station company. Thus the consumers are either partners in the union or customers. Partners are commonly ground owners, customers the more migratory inhabitants. The union provides the necessary capital, generally in the shape of a twenty years' loan from some financial institution made with the partners' share bonds as collateral security to the guarantee of the manager. Every partner has to sign one share bond for 50 crowns per hectare (about $5 per acre) of his cultivated ground. He has, besides, to furnish a certain number of poles from his own property, haul materials and pay certain dues proportional to the number of his share bonds.

These joint-interest unions are commonly organized with about $25,000 capital and are usually managed by a "chairman," whose remuneration is very modest.

TECHNICAL PERFORMANCE

A thorough and extensive investigation, carried out by the Technical Bureau of the Royal Commission on Electrification, has proved that economy in distribution is dependent on density of population, or, more correctly perhaps, on the factor of cultivation—that is to say, the percentage of cultivated area in a certain district. In districts with a low cultivation factor it is advantageous to run 10,000-volt lines, transforming the energy to 380 volts, four-wire, with 220 volts for lighting. In districts more intensely cultivated it is advantageous to run 20,000-volt district lines and step down to 3,300 volts, and in the most densely cultivated districts 1,600 volts is used for local lines, from which small transformers at the different farms reduce the voltage to 220. The former system, operating at 10,000/380 volts, has been named the two-tension system, and the latter, operating at 20,000/3,000/220 volts, the three-tension system. On account of the obviously greater danger of personal injury from 380-volt wires, the three-tension system is recommended in districts where a definite economical advantage from the other is not to be expected.

The map of Sweden (Fig. 2) shows the respective districts where the two systems mentioned are supposed to have decidedly well-grounded application. Evidently, the relative economy of systems is materially dependent on prices and qualities of transformers, price of energy, intensity of consumption and so on.

The substations at the 20,000-volt district lines are mostly small brick buildings. In some parts of the country wooden stands are used, but, on account of danger from fire and cost of maintenance, they are not generally satisfactory. Such a substation, covering the demand from about 100 sq.km. (25,000 acres), generally contains one or two 100-200-kva. transformers, with necessary meters, current and voltage transformers, fuses for the outgoing 3,000-volt lines and so on (Fig. 1). The buses are often reachable from the outside, being installed behind a shutter, usually locked. The neutral point of the transformer is grounded.

The 3,000-volt lines are usually erected on wooden poles carrying three copper wires of 19,800-circ.mil cross-section on porcelain insulators. Commonly no ground wire is used. During the war solid iron wire and cables as a substitute for copper came into use to a great extent.

The 3,300-volt lines are generally run to pole transformers at the different farms, where the voltage is stepped down to 220. Many serious or fatal accidents have called special attention to the need of a perfectly foolproof arrangement. This is provided by the "Edholms swing" (Fig. 3).

Standard three-phase transformers with star-connected primary and Y-connected secondary windings are used where there is motor service. The neutral point on the low-tension side is grounded. The American practice of using two single-phase transformers with open delta connections has found no followers in Sweden.

The size of the transformer is entirely dependent on the amount of power necessary for the threshing machine. On large farms and on small farms where several farmers own a threshing machine in common separate movable transformers are used for threshing and other

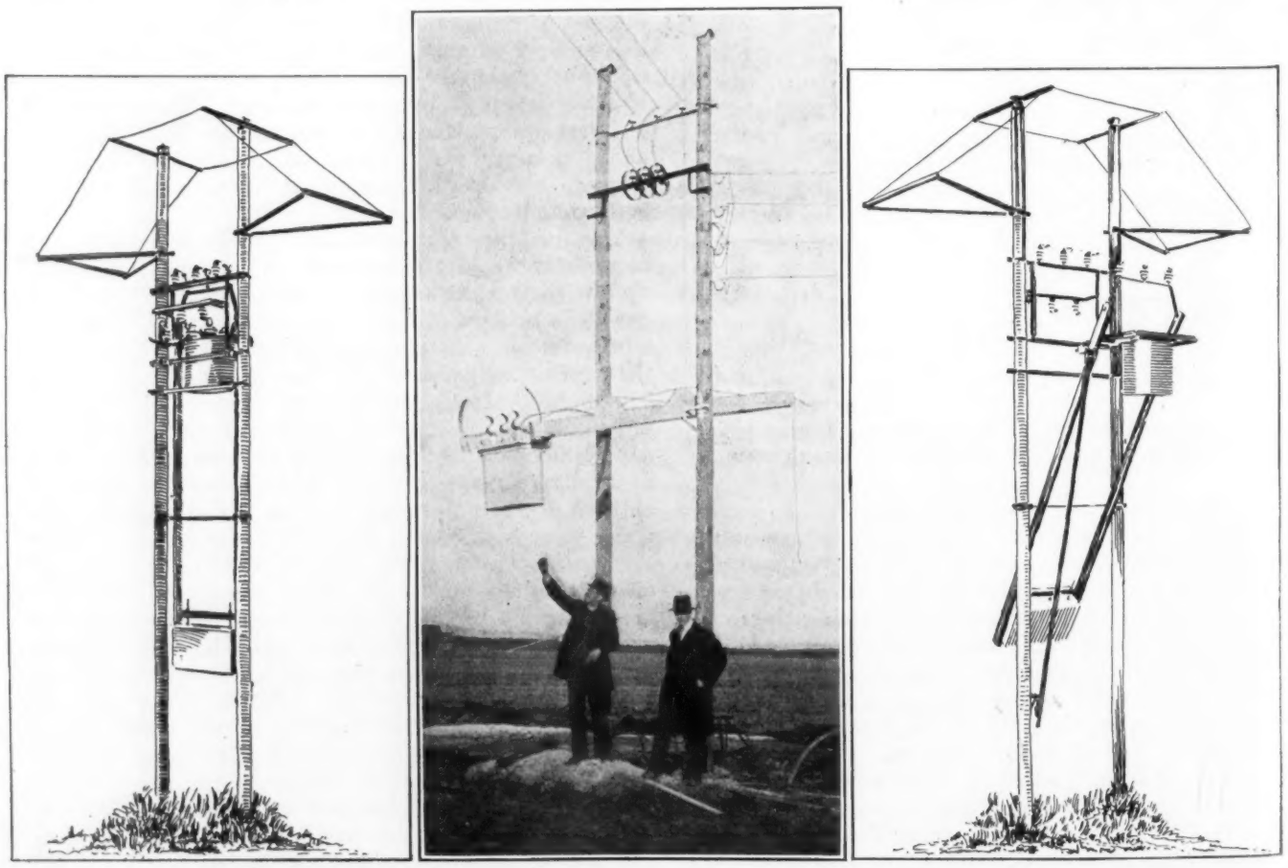


FIG. 3—FOOLPROOF TRANSFORMER ARRANGEMENT BY MEANS OF "EDHOLMS SWING"

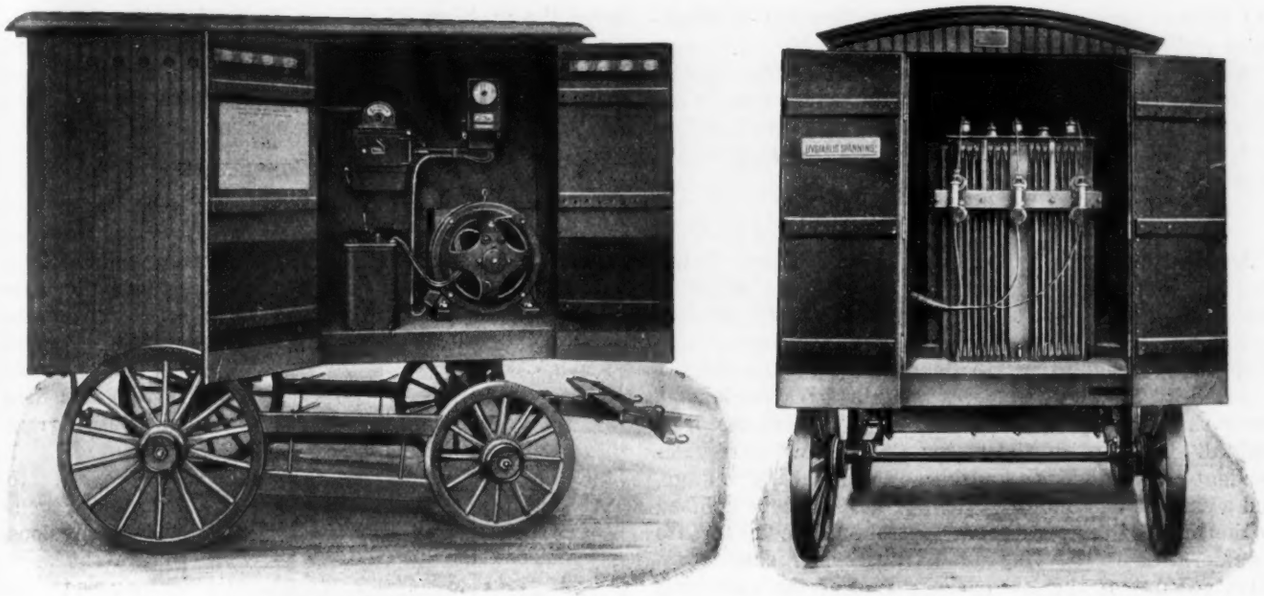


FIG. 4—PORTABLE TRANSFORMER AND MOTOR WAGONS FOR SUPPLYING POWER TO THRESHING MACHINES

heavy work. The motor, meters, etc., are often mounted on the same wagon frame (Fig. 4). The transformer in such cases is temporarily connected with the 3,300-volt line through a special contact device (Fig. 5) and a steel-wire-armored cable.

Although 1,600 volts is often chosen for distributing lines in order to make the direct connection of threshing-machine motors possible, the difficulty experienced in training farm workmen to handle high-tension apparatus and in keeping the motors in order leads farmers to prefer stationary transformers, even in many cases where a clear economical advantage is sacrificed. The economical line between a low-tension and a high-tension motor is supposed to be 11 kw. at 3,000 volts and 9 kw. at 1,500 volts.

A point of special importance is, of course, the core loss from the use of many small transformers. This loss cannot be made very low on account of the voltage regulation. Many ways to reduce this loss have been tried, but hitherto in the long run only the avoidance of an unnecessarily large transformer and the choice of a type with a low flux density and proper laminations have given satisfactory results.

Special Wiring Methods

The wiring methods first used, while, of course, adapted for the home, proved unsuccessful in the stables and especially in the barns, and a lead-covered cable of special design has come to be preferred. Where 220 volts are used for motors it is customary to run a four-wire system with 127-volt, single-phase circuits for lighting.

As for the motors, it has been already mentioned that the threshing motor is the largest used on the farm. The same motor is often employed for crushing macadam, operating a sawmill, etc. Small motors are used for water pumps, milking machines, straw choppers, churns and many other purposes.

Cultivating the soil by electrically driven tools is still a problem that is waiting for a satisfactory solution. Several methods have been tried. The latest (the Forsblads system) comprises a tractor with an electric motor and an armored cable that is coiled and uncoiled by a special device on the tractor, thus having a considerable radius of action. It seems to open new possibilities. Electric plows had previously been used in Sweden only experimentally.

Electrical energy is also used for heating water for the cattle and in the dairy. Quite a new field is the electric conservation of fodder in silos. This has obviously a far-reaching bearing on farming as well as on the distribution of energy, but it can only be mentioned here with a reference to the already imposing literature on the subject based on experience in Germany and Switzerland.

Consumption of Energy

The electrification of a rural district is commonly the result of a popular demand for electric light. The economical importance of other applications of electricity is seldom quite understood in advance among the farmers. As a consequence the demand for energy grows rapidly during the first years of service. In the districts surrounding Stockholm, for instance, the total consumption per hectare of cultivated land has grown, on the average, as follows:

	Kw.-Hr. per Hectare	Kw.-Hr. per Acre		Kw.-Hr. per Hectare	Kw.-Hr. per Acre
1917	15.6	6.3	1920	24.1	9.8
1918	20.2	8.2	1921	29.5	12.0
1919	21.9	8.8	1922	43.0	17.4

Of the 43 kw.-hr. recorded for last year about 16 kw.-hr. represents transmission loss. Of the rest from 10 kw.-hr. to 12 kw.-hr. is used for light, the same amount for threshing and the remaining 3 kw.-hr. to 7 kw.-hr. for small motors. On the bigger and intensively cultivated farms the consumption already amounts to 70 kw.-hr. per hectare (28 kw.-hr. per acre), which means a load factor of nearly 1,000 hours a year.

At first the farmers were very anxious to pay for the consumption of the joint-interest unions at a flat rate. Now there is a prevailing desire for a tariff consisting of a fixed charge per kilowatt per year and a consumption charge per kilowatt-hour as low as possible. It is generally perceived that it is best to keep the consumption rate as low as possible and apportion the fixed cost

per hectare served. In this way consumption is stimulated and a high load factor is made possible.

A difficult question is how to prevent the threshing in an entire district being done at the same time, thus causing a high peak load. This problem is solved differently in different parts of the country, but is everywhere a point of great importance.

SOME EXPERIENCE AND HINTS

As mentioned above, the efficiency of the local distribution is materially influenced by the no-load losses of the small transformers. For this reason it is usual to choose those with low flux density and comparatively poor voltage regulation. This means that the voltage received by the threshing motor at its greatest load is lower than normal, and thus the torque of the motor is limited. The size of the motor is, in other words, dependent on the torque required at the resulting voltage, and a satisfactory motor seldom or never can be utilized to the limit of temperature. This should be taken into consideration in deciding upon transformer size.

On account of the low average load of the threshing and other motors the power factor is very low, and thus the energy loss in the lines is comparatively high. Some unions buy twice as much energy as the consumers receive. Investigations by the author show two ways of improving the situation. One is to develop a good compensated single-phase motor. Even if the first cost of the motor should be 30 per cent higher than that of the common induction motor and its efficiency 5 per cent lower, the power on the shaft would be more than 20 per cent cheaper on account of the smaller transformer with lower core loss, the cheaper single-phase line, the saving in cost of wiring meters and other apparatus. The other way is to use a slipping friction clutch between the motor and the threshing machine. Such a clutch is already in use in Sweden, but on a moderate scale. The clutch begins to slip as soon as the normal torque of the motor is surpassed. Thus it will not only be possible but also very practicable to use a synchronous motor with such a clutch and a small flywheel for the threshing machine. In Germany a new compensated three-phase induction motor running at unity power factor and a self-excited synchronous motor are in the market. This seems to indicate a big step forward.

In the extended distribution lines a fuse sometimes burns out and makes one wire dead. The three-phase motors at moderate load then run as single-phase motors with a rather heavy current. The result has often been burned-out coils, especially in automatically working pump motors. A remedy has been found in the shape of a special relay device that switches off the motor if the voltage drops off from one phase. For this reason and on account of the high cost of three-phase wiring and auxiliary devices a clear tendency to prefer single-phase motors for small demands is to be observed.

It ought not to be concealed that several of the joint-interest unions which carried on their distribution plants during the worst time with substitute materials and at a very high cost have not found the business pleasant. The practice of financing the whole enterprise with borrowed money, the value of which at that time was scarcely more than one-half the present value, of course made interest a heavy burden.

Good voltage regulation is naturally of the same importance in rural districts as in towns. However, threshing in Sweden is never done at the same time when artificial light is required. It is thus possible to solve the problem of voltage drop when the threshing load comes on as an economical question without regard to lighting. Illumination, in fact, is such a small load compared with threshing that transmission lines and transformers will always be adequate for it.

SUMMARY OF CONCLUSIONS

Through the Royal Commission on Electrification and its publications a very good general survey of the electrification of rural districts in Sweden is available, and the investigations made by the Technical Bureau of this commission, by the Board of Waterfalls and by private companies and engineers working in this field will be of great use.

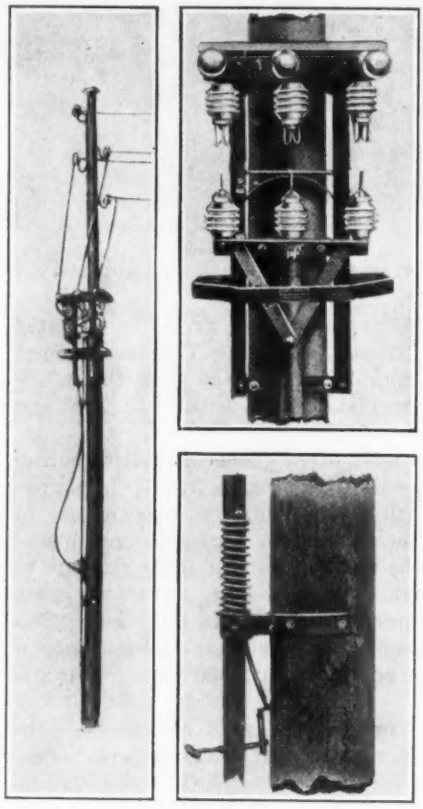


FIG. 5—SPECIAL CONNECTION OF TRANSFORMERS BY MEANS OF A CONTACT DEVICE ON THE POLES

If asked to summarize general conclusions that might be of interest in foreign countries, the author would be inclined to express them as below:

1. An economically good electrification of rural districts requires the cooperation of the vast majority of the farmers.

2. A thorough investigation of the proper system of distribution should be made before the details of electrification are decided. The size and design of transformers on the farms, the magnetizing current of motors and the diversity factor at threshing are points of great importance in this connection.

3. The consumption of energy in the first year is commonly confined to lighting and threshing, but the load increases from year to year, giving a rising load factor. The ultimate average useful consumption cannot yet be estimated, but will certainly be more than 50 kw.-hr. per hectare (18 kw.-hr. per acre) of cultivated area.

4. Where the area of cultivated ground amounts to 25 or 30 per cent of the total area it is usually possible to electrify.

5. The experience of enterprising and energetic farmers seems to be that a supply of electricity is a source of great saving and considerable increase of production.

6. Whether it will be possible for electric tractors to compete with those driven by oil engines, such as are now employed, is not yet practically proved, at least not for a prolonged period of use.

7. The occurrence of many fires has proved the necessity of special methods and great care in indoor wiring.

Lightning Arrester Grounds—II

Multiple-Ground Electrodes—Soil Treatment—Dissipation of Energy in Grounds—Grounds Must Be Watched and Kept in Good Condition

By H. M. TOWNE*
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FUNDAMENTAL considerations of ground resistance and the simpler methods of making grounds, such as by single pipes driven into the ground, were presented in the first part of this article. For a full comprehension of the subject, however, a study of several other factors is advisable:

Multiple-Ground Electrodes

The average electrical resistance of a single driven pipe is in nearly all cases too high to be classed as an adequate earth connection for a lightning arrester. This is particularly true of the larger arrester installations on the higher-voltage distribution circuits and power-transmission systems where a large discharge rate through the arrester to earth is imperative. A system of parallel or multiple driven pipes is the simplest solution of the problem of minimizing the resistance and amplifying the allowable discharge rate. The number of pipes to be connected in multiple depends entirely upon the soil resistivity at the point of installation and the combined resultant resistance desired. Obviously, economy lies in getting the greatest possible benefit from each of the pipes, and this requires attention to the spacing between them. It has already been stated that about 90 per cent of the resistance of a pipe ground will be within a radius of 6 ft. to 10 ft. around the pipe. For this reason multiple pipes should preferably be spaced at least 6 ft. apart, thus keeping one out of the dense current field of the other. With this spacing each added pipe introduces a new cross-sectional area of unused soil and will decrease the combined multiple resistance by an amount approximately inversely proportional to the number of pipes.

In some instances, particularly in pole-type arresters for power distribution, space is not always available to permit driving multiple-ground pipes the recommended distance apart. This limitation should not discourage the use of multiple pipes, since much can be accomplished using multiple pipes with only 1-ft. spacing. By referring to Fig. 8 it will be seen that more than 50 per cent of the resistance reduction is effected by the first foot spacing between pipes, and consequently large benefits may be had by multiple pipes even in limited space. Where it is necessary to drive pipes relatively close to a wooden pole, as is customary with the pole-type arresters, a considerable reduction may be had by driving two pipes on opposite sides of the pole. A single pipe driven close to the pole is adversely affected by the pole, which is of higher resistivity than the soil and shuts off a large part of the current flow away from the single pipe. Three pipes driven at equal distances around the pole form a good combination where the available space is limited. It should be known, however, that the combined resistance of multiple pipes driven close together does not reduce proportionately with the number of pipes, and the presence of a wooden pole in close proximity to the pipes will augment this tendency. For instance, one experiment has shown that two pipes driven on opposite sides of a pole had a combined resistance of about 65 per cent of a single pipe, and three pipes spaced 120 deg. apart around the pole had a combined resistance of about 53 per cent of a single pipe. Where space is not a factor multiple pipes should be separated a distance of 6 ft. to 10 ft., and the combined resistance will decrease approximately in proportion to the number of pipes.

Artificial Treatment of Soil

Multiple pipes, even in large number, will frequently fail to produce an adequately low resistance to earth. This condition will attend installations involving soil of high resistivity. For gravelly soil with sand and but little clay or loam the average single pipe resistance is 554 ohms. Assuming a resistance reduction proportional to the number of pipes, it would require about a hundred pipes in multiple to effect a good lightning-arrester ground in this class of soil. While such poor soil for arrester locations should be avoided wherever possible, there are cases offering no choice and where the poor soil conditions have to be dealt with. To use 100 pipes in multiple would of course be very expensive and require quite unreasonable space. The one alternative is to reduce the resistivity of the soil immediately surrounding the pipes, thus enabling the attainment of a low resistance with a relatively small number of pipes in multiple. To reduce the resistivity of any class of soil it is only necessary to dissolve in the moisture normally contained in it some substance which is highly conducting in its water solution. There are many such substances, but those most suitable are sodium chloride (NaCl), better known as salt, and calcium chloride ($CaCl_2$). Both are comparatively cheap and form solutions having resistivities of about 1 per cent of ordinary ground water. They have the disadvantage of promoting corrosion of the ground electrode, but not in sufficient degree to affect in any way their advantage in reducing soil resistivity. Probably salt is the more corrosive, but, on the other hand, salt is very much cheaper than calcium chloride, and for the latter reason it is preferable in the majority of cases. Sodium carbonate (Na_2CO_3), which is ordinary washing soda, may be used and will have less corrosive effect than the salt, but in solution the soda has a higher resistivity and is therefore less effective in reducing soil resistivity. The slight corrosive effects of salt should not prevent its use with pipe grounds.

The question of how much salt is required for each

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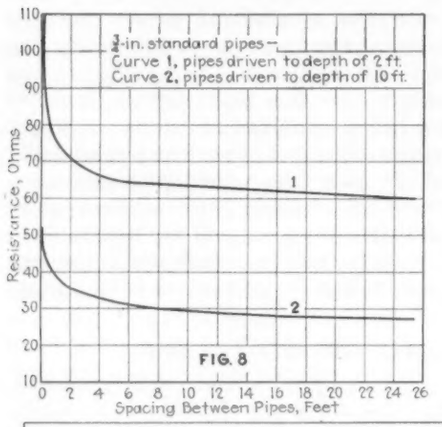
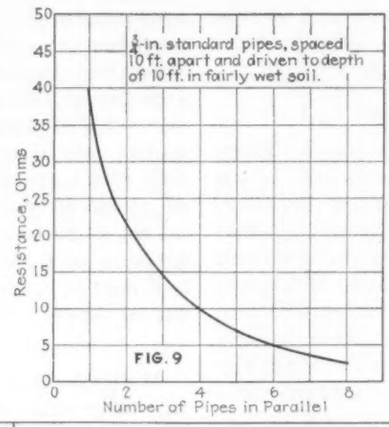
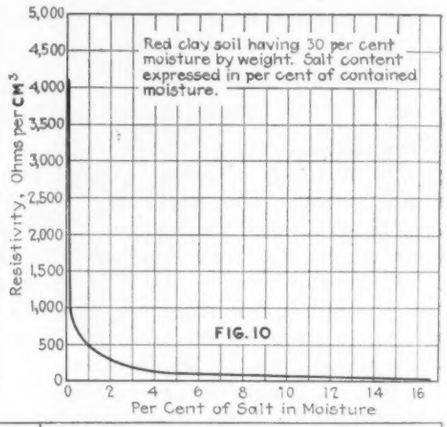
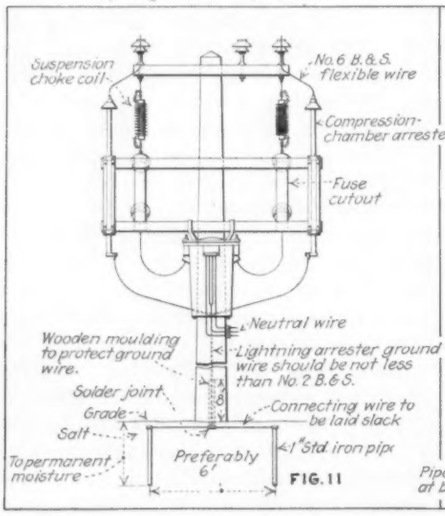
pipe ground naturally arises. It has been already stated that about 90 per cent of the resistance of a driven pipe lies within a 6-ft. to 10-ft. radius around the pipe. Here we will assume the smaller figure and also assume a pipe driven 8 ft. deep. The cylinder of earth surrounding the pipe has dimensions of 12 ft. diameter and 8 ft. depth, or a cubic capacity of about 900 cu.ft. Assume a moisture content in the soil of 16 per cent as a probable average. This percentage of moisture means 12,960 lb. of water in this cylinder of earth. To make a 1 per cent solution of this water requires the addition of 129 lb. of salt. This amount of salt properly dissolved and diffused throughout the cylinder of soil would reduce the resistance of a driven pipe to about 12 per cent of its natural value. The addition of one-half this quantity of salt, or about 65 lb., would form a half of 1 per cent solution, and this would reduce the resistance to 16 per cent of the natural value. Some advantages of the salt not generally recognized are its hydroscopic properties, tending to retain moisture, and also its effect in counteracting changes in moisture content, with consequent smoothing out of seasonal fluctuations of the ground resistance. For instance, changing the moisture content in soil from 40 per cent to 20 per cent causes an increase in resistivity of around 40 per cent. When salt is present the reduction in moisture content results in increased concentration, which means decreased resistivity, and the latter effect entirely offsets the increase by moisture reduction. The effect of salt, however, in producing uniformity of resistivity becomes less with increased dryness of soil, but its tendency is in the right direction. The presence of salt also lowers the freezing point of the water in the soil and thus lowers the point of sudden large increase of resistivity (see Fig. 2) several degrees below the freezing point of water. This also tends to minimize the seasonal variation.

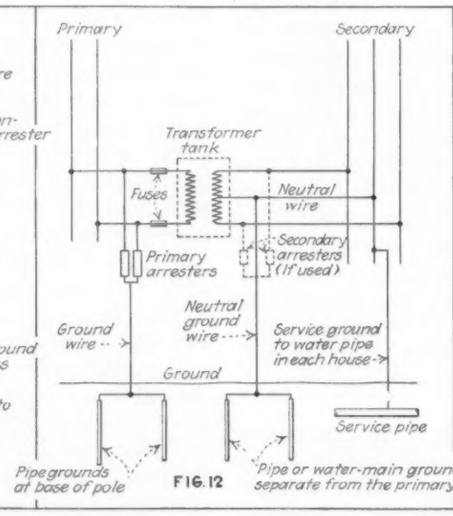
The practical application of salt to a driven pipe should consist of excavating a basin about 2 ft. in radius around the pipe after it is driven. This basin should be about 1 ft. deep. About 65 lb. to 150 lb. of salt should be poured in this basin and covered with earth. A simple method of applying the salt when installing the ground connection is first to drive a 2-in. pipe to a depth of 4 ft. or 5 ft. and then to remove it and fill the hole with salt. The ground pipe is then driven through the salt and some soil packed around the top to cover the salt. The ground pipe should always be driven to a much greater depth than the hole containing the salt to insure pressure contact with soil over the greater length of the pipe. In either case the soil around the pipe should be subsequently flooded with

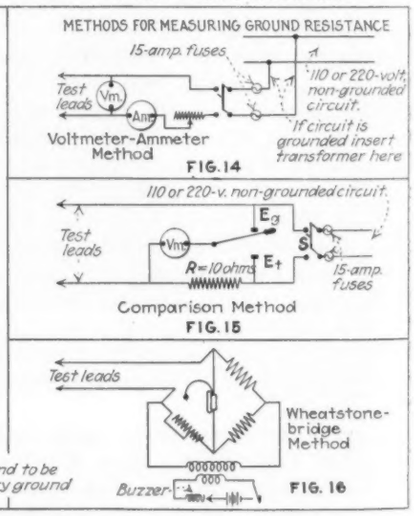

¾-in. standard pipes—
Curve 1, pipes driven to depth of 2 ft.
Curve 2, pipes driven to depth of 10 ft.
Resistance, Ohms
Spacing Between Pipes, Feet
FIG. 8


¾-in. standard pipes, spaced 10 ft. apart and driven to depth of 10 ft. in fairly wet soil.
Resistance, Ohms
Number of Pipes in Parallel
FIG. 9


Red clay soil having 30 per cent moisture by weight. Salt content expressed in per cent of contained moisture.
Resistivity, Ohms per CM³
Per Cent of Salt in Moisture
FIG. 10







DATA AND RESISTANCE MEASUREMENTS FOR ARRESTER GROUNDS

Fig. 8—Effect of spacing on the combined resistance of two driven pipes connected in multiple. It will be noted that these curves become nearly flat at about 6-ft. spacing and but little reduction of resistance is effected by greater spacing.

Fig. 9—Reduction in resistance effected by more than two pipes in parallel and spaced 10 ft. apart.

Fig. 10—Variation of soil resistivity with salt content.

Fig. 11—Recommended method of grounding for pole-type lightning arresters protecting distribution transformers.

Fig. 12—Recommended arrangement of primary and secondary grounds.

Fig. 14—Volt-ammeter methods of measurement.

Fig. 15—Comparison method of measurement.

Fig. 16—Wheatstone bridge method.

water, which will dissolve the salt and carry it deeper into the ground. A second flooding of the soil around the pipe is desirable after two or three days, particularly if the soil is not naturally quite moist. Rains will take care of the further necessary water applications unless the pipe is where the soil is naturally very dry or rains are quite infrequent, in which case a periodic wetting of the soil is desirable. The grade of salt is not important, but probably the cheapest and most satisfactory is the so-called pea-size "ice-cream salt." The finer rock salt and so-called "cattle salt" are also very good and quite inexpensive.

Ground connections can dissipate energy at a certain limited rate. This rate depends upon the moisture content of the soil, the rate and distance moisture will travel by capillary action, the amount of salt used, the size and number of the ground electrodes, temperatures and other factors. If the rate is exceeded, drying of the soil will occur with great increase in resistance. A pipe driven about 10 ft. in moist, moderately salted soil will generally have capacity to dissipate energy at a rate of from 5 kw. to 20 kw. without an increase in resistance. From the standpoint of overvoltage discharge energy through the ground connection, there is no danger of exceeding the energy dissipation capacity of a lightning-arrester ground connection. For instance, assuming a 5-ohm ground resistance and a lightning discharge of 1,000 amp. through the ground connection to earth, the energy dissipated in the ground resistance would be I^2R, or 5,000,000 watts. The time duration, however, of the discharge would be not over say 10 micro-seconds (0.000010 second), and so the total energy expenditure is only 50 watt-seconds. Assuming the minimum rate of dissipation estimated for the pipe, which was 5 kw., an hour at this allowable rate would represent 5,000 watt-hours or 300,000 watt-seconds. There would, therefore, have to be more than 6,000 of the 50-watt-second energy expenditures per hour, or more than 100 per minute, in order to exceed the minimum allowable rate of a single ground pipe. Fortunately, 1,000-amp. transient discharges at the rate of 100 per minute would be a tremendous exaggeration of what we actually cope with in service, and so it is evident that the baking out of a ground connection because of lightning discharges is quite removed from probability.

The danger of arrester grounds baking out by excessive energy dissipation may be more correctly associated with dynamic current following with lightning discharge, and this is only possible with the very inferior types of arresters which are so sluggish in their arc-rupturing characteristics as to permit a heavy dynamic current of flow through the arrester for several seconds after the overvoltage is discharged. Such an arrester of single-pole type connected to a line wire of a grounded neutral system, and under condition of a prolonged succession of discharges such as could be caused by an arcing ground on one of the other line wires, might bake out a poorly constructed ground connection. However, modern arresters possessing rapid self-restoring or arc-rupturing properties would be very unlikely to allow any approach to the energy-dissipating capacity of a single driven pipe ground. The greatest trouble with baking out of grounds is with the earth connections for neutrals, which may have to carry a large amount of current. Very large energy-dissipating capacity requires many ground electrodes in multiple in very moist soil which has been salted liberally.

Fig. 11 shows the recommended method of grounding for pole-type lightning arresters protecting distribution transformers. Under average soil conditions this method should provide a resistance of 15 ohms or less, which, if maintained, will be adequate for the pole-type arresters. A single driven pipe, if liberally salted, will frequently give a suitably low-resistance value for arresters on the customary 2,300/4,000-volt class of distribution circuits, particularly in regions of large arrester density. A ground resistance much above 15 ohms becomes questionable, particularly in sections where the transformer density is minimum—that is, where the number of discharge paths in parallel would be minimum—thus requiring the total energy induced

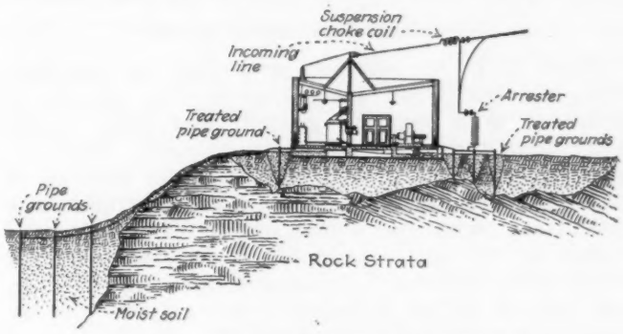


FIG. 13—OVERCOMING ADVERSE CONDITIONS

The method of securing reliable arrester ground connection under adverse topographical conditions. Rock strata isolate the soil on which the substation is constructed, and the thin layer of soil present does not permit the pipes to be driven to permanent moisture. A system of multiple driven pipes is installed at the point of arrester location, and these driven pipes are treated freely with salt. These treated pipe grounds should receive frequent flooding with a hose. This ground system is connected to the steel framework of the substation structure and also to the frames and cases of the electrical machines in the building. Supplementary treated pipe grounds may be installed around the structure and connected in with that already described. In such cases it may happen that at a few yards distant the topography is improved and good soil condition is found, and the reliability of the grounds on the rock strata can be improved by connecting them, using heavy copper cable, to additional multiple pipes driven deep at the nearest good soil location. These are shown at the left of the illustration.

Attention is called to the "hairpin loop" connection between the incoming line and the lightning arrester. This V-shaped loop is connected on both sides of a strain insulator inserted in the line. Directly in back of the strain insulator is the ideal location for the suspension choke coil. With this method of connecting the arrester to the line an incoming lightning disturbance or traveling wave must be conducted right to the arrester terminal before it can continue on toward the station. The very sharp angle bend between the arrester terminal and the choke coil, combined with the choke coil itself in the position illustrated, form an effective impedance to further travel of the disturbance or wave beyond the point of the arrester terminal.

on the circuit over a considerable area or length of line to be discharged through but one or two arrester installations. In other words, the minimum ground resistance is desirable in areas of minimum installation density. Examples of minimum arrester density would be an alternating-current signal feeder circuit where transformers with arresters are separated a mile or more apart, or the rural extension of a power distribution feeder.

It is interesting to consider the effect of a high-resistance ground connection on the protection afforded by a lightning arrester. Consider a discharge current through a distribution circuit arrester connected to a 200-ohm ground resistance. Assume a 200-amp. discharge current. This will cause a voltage drop across the 200-ohm ground resistance of 200 $\times$ 200, or 40,000 volts. In other words, the ground electrode will be 40,000 volts above ground potential, and the ground terminal of the arrester will be even higher than this, allowing for the impedance drop of the ground wire. Something more has got to be added for the voltage

drop across the arrester, and the result is a voltage from transformer terminal to ground which may easily cause insulation failure. By cutting the ground resistance down to 10 ohms the strain on the transformer is reduced by 38,000 volts. It will be noted that the ground pipes and connecting bus in the illustration are under the surface of the ground. This is recommended in the interest of human safety and should be practiced wherever the installation is accessible and in populated districts. Where the risk to human safety is not present, advantages in inspection and testing will be had from keeping the top of the pipes and all connections just above the ground surface. This may be possible in rural sections, in which cases the molding over the ground wire may be dispensed with.

SECONDARY GROUNDS ISOLATED

Where there are arresters protecting the secondary side of distribution transformers, they should be grounded to a separate ground, preferably a pole away from the primary arrester ground. This rule also applies to the ground connection for neutrals of secondary circuits. The correct practice is quite well established owing to the obvious risk to property and human safety which would follow the employment of common ground for high-tension lightning arresters and the low-tension arresters or neutral. If primary arresters and secondary arresters or secondary neutral are grounded through one ground wire and ground electrode, it is possible because of a defect in the one ground electrode or ground wire to have the primary arrester overvoltage discharges pass to the secondary circuit, with attending danger of secondary insulation and hazard to life on the secondary service. There is, however, no general objection to connecting the secondary neutral to the same ground connection provided for the secondary arresters. The recommended arrangement of primary and secondary grounds is shown diagrammatically in Fig. 12. It will be noted that the transformer case is shown ungrounded. This may be grounded to the same ground wire used for the primary arresters, and slightly improved protection will result. On the other hand, a grounded transformer case increases the danger to linemen, and where this is practiced the linemen should be properly instructed as to the best methods of safeguarding themselves while at work. The better practice is to leave the transformer case isolated.

COMMON NEUTRAL GROUND-WIRE DISTRIBUTION SYSTEM

This system employs a common ground wire which serves for the neutral of the 2,300/4,000-volt Y-connected primary distribution, for the neutral of the 110/220-volt secondary and also for both primary and secondary arrester grounds. The whole success of this system lies in securing practically zero or earth potential for the common neutral wire throughout the entire primary and secondary distribution, and this condition is possible by very frequent earthing to the water system and other reliable ground electrodes. Where it is difficult to get good driven pipe grounds, the common neutral wire system affords advantage in the way of a uniformly reliable ground for arresters without necessarily requiring a ground electrode at the arrester location. The common neutral ground wire is preferably carried on the middle spool of the secondary rack. One advantage claimed is that only one-half of the transformer auxiliary equipment is required as compared with the delta system or the Y system with neutral grounded at the substation only. This system has been used in a few large cities for a number of years and has given very satisfactory results as to both reliability and economy.

INSPECTION

To obtain continuous and reliable service from lightning-arrester grounds requires, in addition to good mechanical construction, a systematic routine inspection. An inspection and electrical measurement of ground resistances of all lightning-arrester grounds should be made in the early spring and all repairs immediately completed. Subsequent inspections should follow every month or two thereafter throughout the lightning season. An electrical measurement of the resistance between a lightning-arrester ground and earth should be made after the initial construction of the ground, and a testing schedule should be inaugurated for further measurements in the interest of maintenance. This work should be preferably assigned to a responsible man as the conditions under which measurements must be made vary so widely that no established routine methods can be employed. Obtaining reliable results often rests on the initiative and intuition of the man actually doing the work. An analysis of the test readings on the spot is desirable, in which case a high-resistance indication may be followed by inspection and remedy before leaving the location. A record should be kept showing the exact plans of the ground electrodes and connecting wires, with their location specified, and this record should include a brief description of the electrical tests, giving the results.

Where there are at least three driven pipes not less than 6 ft. apart, the actual resistance of each pipe can be obtained with fair accuracy by an ammeter-voltmeter method of test between the pipes in series. With the three pipes identified as A, B and C the series resistance of A to B, B to C, and C to A should be measured, and solution of simple algebraic equations will give the individual resistances. For this test connect a non-grounded 110-volt or 220-volt alternating-current or direct-current supply through a regulating rheostat and an ammeter to the two pipes—say A and B. A voltmeter is connected across the terminals which connect to the pipes. The function of the rheostat is to limit the current to a safe value (5 amp. to 10 amp.) in case the resistance between the ground pipes is of very low value. Fig. 14 shows the connection diagram. After closing the switch the current should be adjusted to say 5 amp. by the rheostat, and after the conditions become fairly constant readings of amperes and volts should be taken as nearly simultaneously as possible. The voltage divided by the current gives the resistance between the two pipes tested and is the resistance of the two in series. Now, assume that the readings for $A + B = 16$ ohms, and $B + C = 18$ ohms, and $C + A = 10$ ohms. Solving:

	Ohms	
	$A + B = 16$	(1)
	$B + C = 18$	(2)
Subtracting:	$C - A = 2$	(3)
	$C + A = 10$	(4)
	$2C = 12$	
	$C = 6$	
	$A = 10 - C = 4$	
	$B = 16 - A = 12$	

Thus, having obtained the individual resistances, the combined resistance of the three pipes connected in multiple will be the reciprocal of the sum of the reciprocals, viz.,

$$R = 1 \div (\tfrac{1}{8} + \tfrac{1}{4} + \tfrac{1}{2}) = 2 \text{ ohms.}$$

The above algebraic solution for individual resistances will be fairly accurate only when all of the pipes are identical, equally spaced, not less than 6 ft. apart, and the soil condition is uniform for all three pipes.

Where the resistance of only one driven pipe is to be measured, there must be some auxiliary ground to use in testing, either of known value or of negligible value. A very reliable auxiliary ground is a water-pipe system, and in urban districts this is usually quite available either by attaching to a street hydrant or to near-by service pipes. The resistance of a water-pipe system to earth is generally a fraction of an ohm, and 2 ohms would be extraordinarily high. The water pipe is therefore the best obtainable auxiliary ground to use in testing arrester grounds, and its resistance may be entirely neglected in the computation of the arrester ground resistance. The voltmeter-ammeter method may be used, attaching one test lead to the pipe or multiple pipes forming the arrester ground and the other lead to the water-pipe system. If the nearest water-pipe connection is some distance away, the resistance of the leads may be measured and subtracted from the ground measurement to give an accurate net resistance value for the arrester ground.

A very simple and quite reliable method of test is shown in Fig. 15, which consists of comparing the unknown resistance to a known resistance. The known resistance R should be about 10 ohms, non-inductive, and capable of carrying as high as 10 amp. without change of resistance. One test lead is connected to the arrester ground and the other test lead to the auxiliary ground, and the circuit is closed by the switch S. The single-pole, double-throw switch is first thrown so that the voltmeter is across the known resistance R and reading of volts (E_r) is taken. The switch is then thrown so that the voltmeter is across the ground resistance and a second reading of volts (E_g) is taken. The resistance of the arester ground will then be:

$$R_g = R(E_g/E_r).$$

Using 110-volt supply with a 150-volt, 3,000-ohm alternating-current voltmeter, quite accurate measurements can be made over a ground resistance range from 2 ohms up to several hundred ohms. The advantage of this method is in requiring only one instrument and no rheostat, making the outfit quite portable. A 110-volt storage battery with a direct-current voltmeter may be used with this method where the 110-volt alternating-current supply is not available. Using a direct-current source of current for tests, the error due to possible counter emf. of electrolysis will be entirely negligible if the voltage used in testing is not much less than 100. The counter emf. of electrolysis would not be more than 2 volts or 3 volts, which is quite a negligible percentage of the test voltage above recommended, and the error involved would be much less than the normal diurnal changes in the ground resistance and may therefore be justly neglected.

The Wheatstone bridge method of measurement, which will give results within an accuracy of 5 per cent of alternating or oscillating current, is used, as shown in Fig. 16. The alternating current is obtained by the combination of a primary battery of three dry cells in series, a push-button, a make-and-break device such as a call bell or 4-ohm buzzer and a very small transformer having about a one-to-ten ratio. The bridge method of test fails, however, when for any reason alternating currents are induced from some external source into the ground circuit. These induced currents will make the telephone receiver too noisy to make an accurate balance of resistances. Another disadvantage of the bridge method is that it does not give any indication of the stability of the ground connection to dynamic currents.

There are other methods of testing which possess more or less merit but they will not be defined here. The main points to stress are that whatever method is adopted should permit a good degree of accuracy and that the tests be conducted in earnest, systematic routine fashion. It would be economy for many operating companies to fit up a truck with complete portable equipment for measuring arrester ground resistances and include in the outfit all repair equipment, such as pipes, salt, etc., which could be utilized at the time of tests upon finding a faulty ground.*

Central-Station Customers Total 12,353,790

BASED upon the countrywide survey which the ELECTRICAL WORLD conducted during the past year to ascertain the number of central-station customers of the various classes by counties, it is estimated that there were on Jan. 1, 1923, a total of 12,353,790 such customers. Of this total 9,903,830, or 80.2 per cent, were domestic lighting customers; 1,988,020, or 16.1 per cent, were commercial lighting customers, and 461,940, or 3.7 per cent, were industrial power customers. These figures were checked by companies operating in the various counties and are believed to represent the central-station field with thorough accuracy.

It is estimated that there were 16,991,540 potential domestic lighting customers in the United States, including the present customers of that class. This would indicate that there are about 73,600,000 people in the country who are possible users of electrical energy from central-station lines. This figure does not represent the total population of the territories covered by central-station lines at the present time, for in some of the largest cities there are certain districts now using gas which the central-station companies serving these cities do not consider to possess any value as potential customers. The population covered by the central-station lines is therefore probably well over the seventy-five million mark.

The accompanying table gives the above information by sections and states. It is estimated that 58.3 per cent of the potential domestic lighting customers of the country are now developed, that 57.9 per cent of the potential commercial lighting customers are developed and that 49.0 per cent of the potential industrial power customers are developed. The total number of potential customers of all classes at the present time is estimated as 21,368,410, which includes the present actual customers.

Turning to the details of this tabulation, a very clear picture is presented of the present degree of electrical saturation of the various states. Although New York State leads with 1,062,280 domestic lighting customers at the present time, yet only 49.3 per cent of the total

*The author wishes to acknowledge indebtedness to data obtained in the Bureau of Standards Technologic Papers Nos. 25 and 108.

number of potential domestic lighting customers in this state—that is, those within reach of central-station lines—have been developed. On the other hand, Illinois, while reporting 1,004,830 domestic lighting customers, slightly fewer than New York State, has developed 71.3 per cent of the potential customers of this class. Such a comparative study of the degree of domestic lighting saturation in the various states indicates that the greatest field for the development of the domestic lighting customer, in the near future at least, lies in the Eastern and Southern States. The explanation for this is probably in the fact that in the New England and Middle Atlantic States a large portion of the population in the cities are using gaslight installations dating back to the days before electric light was available, and in the Southern States the large colored population presents a field which is naturally slow in developing.

The largest number of commercial lighting customers is to be found in those states and sections having the largest cities. New York State leads with 267,330 commercial lighting customers, of which 178,110, or 67 per cent, are in the five boroughs of New York City. Illinois, Pennsylvania and California are the other three states with over one hundred and fifty thousand commercial lighting customers at the present time.

California leads in the number of industrial power customers with 66,140, this large number being due in the main to the great number of irrigation and farm customers.

Present and Possible Central-Station Customers

State and Sections	Population (Census of 1920)			Domestic Lighting Customers		Commercial Lighting Customers		Industrial Power Customer	
	Total	Urban*	Rural	Total Jan. 1, 1923	Total Potential (Including Present Customers)	Total Jan. 1, 1923	Total Potential (Including Present Customers)	Total Jan. 1, 1923	Total Potential (Including Present Customers)
UNITED STATES	105,710,613	59,447,751	46,035,772	9,903,830	16,991,540	1,988,020	3,434,760	461,940	942,110
New England	7,400,909	6,158,044	1,012,775	910,610	1,639,430	196,620	328,360	47,840	102,250
Middle Atlantic	22,261,137	17,582,909	4,678,228	2,124,320	4,450,610	516,290	1,075,450	89,180	179,040
South Atlantic	13,990,272	4,811,889	9,178,383	629,820	1,105,130	139,420	224,670	29,830	69,950
East North Central	21,475,543	14,144,931	7,330,612	2,781,050	4,239,610	487,520	776,440	110,060	217,010
West North Central	12,544,249	5,632,389	6,914,860	1,106,980	1,931,310	213,520	381,710	47,210	110,090
East South Central	8,893,307	2,337,725	6,555,582	288,280	614,200	49,280	104,110	13,000	41,100
West South Central	10,242,224	3,513,956	6,728,268	637,060	838,450	98,120	130,380	24,270	58,210
Mountain	3,336,101	1,513,474	1,822,627	361,350	438,020	57,800	70,110	16,610	24,580
Pacific	5,566,871	3,752,434	1,814,437	1,064,380	1,734,780	229,450	343,530	83,940	139,880
NEW ENGLAND									
Maine	768,014	551,055	216,959	110,550	168,960	26,210	37,190	5,160	16,260
New Hampshire	443,083	376,860	66,223	42,450	104,050	9,820	24,290	2,610	7,870
Vermont	352,428	204,464	147,864	50,220	74,540	12,490	18,570	2,470	3,780
Massachusetts	3,852,356	3,650,248	202,108	461,860	881,120	106,460	176,800	23,600	44,930
Rhode Island	604,397	359,180	15,217	72,000	137,970	12,250	23,990	4,010	10,020
Connecticut	1,380,631	1,016,227	364,404	173,530	272,790	29,390	47,520	9,990	19,390
MIDDLE ATLANTIC									
New York	10,385,222	8,890,049	1,495,173	1,062,280	2,159,160	267,330	559,380	38,770	65,810
New Jersey	3,155,900	2,658,047	497,853	376,270	648,540	74,320	150,480	17,570	44,370
Pennsylvania	8,720,015	6,034,813	2,685,202	685,770	1,642,910	174,640	365,590	32,840	68,860
SOUTH ATLANTIC									
Delaware	223,003	137,022	85,981	17,780	30,040	5,380	7,990	730	1,050
Maryland	1,449,661	922,665	526,996	111,560	222,220	24,060	48,400	6,270	12,470
Dist of Columbia	437,571	437,571	0	39,840	60,000	13,630	14,000	580	600
Virginia	2,309,187	737,146	1,572,041	83,220	176,500	8,490	18,160	6,280	19,350
West Virginia	1,463,701	431,188	1,032,513	63,640	110,030	13,850	20,100	2,530	5,940
North Carolina	2,559,123	581,369	1,977,754	82,420	131,440	23,840	38,700	4,310	11,310
South Carolina	1,683,724	306,937	1,376,787	47,440	89,910	12,430	20,020	1,840	3,750
Georgia	2,895,832	827,745	2,068,087	104,770	161,020	21,120	30,920	4,730	9,700
Florida	968,470	430,246	538,224	79,150	123,970	16,620	26,380	2,560	5,780
EAST NORTH CENTRAL									
Ohio	5,759,394	3,915,235	1,844,159	736,850	1,145,270	110,990	179,910	27,720	57,790
Indiana	2,930,390	1,654,750	1,275,640	322,500	604,680	53,260	99,570	15,870	35,900
Illinois	6,485,280	4,756,462	1,728,818	1,004,830	1,410,600	183,950	283,970	29,920	51,340
Michigan	3,668,412	2,445,226	1,223,186	487,430	670,480	84,080	115,740	19,920	29,260
Wisconsin	2,632,067	1,373,258	1,258,809	229,420	408,580	55,240	97,250	16,630	42,720
WEST NORTH CENTRAL									
Minnesota	2,387,125	1,205,541	1,181,584	303,890	365,630	57,680	79,610	11,650	24,690
Iowa	2,404,021	1,075,626	1,328,395	193,140	396,570	43,750	80,750	9,210	19,890
Missouri	3,404,055	1,797,910	1,606,145	306,840	586,140	57,930	117,230	13,140	30,600
North Dakota	646,872	125,264	521,608	16,380	45,050	2,910	8,540	1,090	2,630
South Dakota	636,547	161,097	478,850	31,760	61,830	5,770	11,120	1,930	4,440
Nebraska	1,296,372	522,963	773,409	72,080	193,970	14,270	38,480	3,900	9,920
Kansas	1,769,257	743,988	1,025,269	182,890	282,120	31,210	45,980	6,290	17,920
EAST SOUTH CENTRAL									
Kentucky	2,416,630	705,516	1,711,114	83,250	198,220	17,010	37,900	4,460	15,190
Tennessee	2,337,885	670,552	1,667,333	92,590	188,830	16,480	32,820	4,220	10,420
Alabama	2,348,174	640,062	1,708,112	80,750	146,690	9,150	16,450	2,720	9,980
Mississippi	1,790,618	321,595	1,469,023	31,690	80,460	6,640	16,940	1,600	5,510
WEST SOUTH CENTRAL									
Arkansas	1,752,204	368,737	1,383,467	74,620	101,010	14,080	18,600	2,260	5,580
Louisiana	1,798,509	661,186	1,137,323	72,320	120,800	16,730	26,990	3,320	6,970
Oklahoma	2,028,283	699,497	1,328,786	126,320	182,530	18,470	26,570	8,870	20,680
Texas	4,663,228	1,784,536	2,878,692	363,800	434,110	48,840	58,220	9,820	24,980
MOUNTAIN									
Montana	548,889	203,819	345,070	47,480	61,720	9,040	12,000	4,300	5,940
Idaho	431,866	155,600	276,266	44,120	48,480	10,700	12,180	1,350	2,250
Wyoming	194,402	90,751	103,651	23,850	27,630	3,350	3,790	860	1,400
Colorado	939,629	494,555	445,074	125,210	147,930	17,240	20,150	6,440	9,120
New Mexico	360,350	87,352	272,998	17,490	22,660	2,960	3,990	610	1,370
Arizona	334,162	154,033	180,129	21,580	39,210	2,750	4,880	750	1,210
Utah	449,396	285,892	163,504	70,130	76,150	9,860	10,930	1,950	2,550
Nevada	77,407	41,472	35,935	11,490	14,240	1,900	2,190	350	740
PACIFIC									
Washington	1,356,621	838,090	518,531	215,090	326,640	38,360	56,350	10,530	22,120
Oregon	783,389	446,796	336,593	103,310	178,360	18,340	30,440	6,800	11,490
California	3,426,861	2,467,548	959,313	745,980	1,229,780	172,750	256,740	66,610	106,270

*Cities and towns of over 1,000 population.

Measurement of Voltage Peaks

Zero Method Using Portable Standard Apparatus and Applicable with Accuracy to Any Periodic Voltage

BY RALPH D. MERSHON
New York, N. Y.

SOME time ago some of my work called for the accurate measurement of the peak value of voltage waves. The existing schemes for such measurement, based on a rectifier charging a condenser, did not strongly commend themselves for my purposes. Finally, I devised a scheme for measuring voltage peaks that requires only standard apparatus that is easily portable,

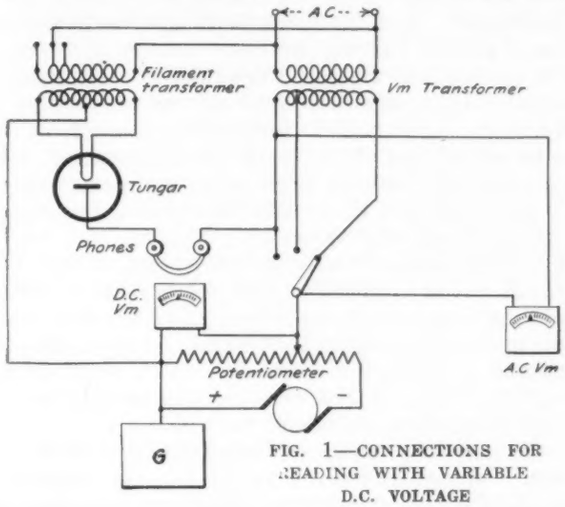


FIG. 1—CONNECTIONS FOR READING WITH VARIABLE D.C. VOLTAGE

and that can be carried to any degree of accuracy desired without especially skillful handling. It can be applied to any periodic voltage, pulsating or alternating. As it is a zero method, it can be used where a method requiring flow of current would introduce serious error.

It consists in using a rectifying tube to rectify the voltage (or a known fraction thereof) whose peak is to be measured and balancing the rectified voltage against a direct-current voltage, using a telephone to indicate a balance.

The embodiment of the scheme, as applied to alternating voltages, is shown in the accompanying diagrams. Referring to Fig. 1, the method of operation is similar to that of any potentiometer scheme of measurement, except that whereas in the case of the usual potentiometer scheme an indication of unbalance is had on each side of the balancing point, in this case there is an indication of unbalance only when the balancing direct current is *less* than the peak to be measured. When starting to take a reading, it is well to apply the direct-current voltage to the circuit before applying the alternating current, and to set the potentiometer for a direct-current voltage considerably in excess of the estimated value of the peak to be measured. The potentiometer voltage will then control, and since the tungar will not pass current in the direction of the potentiometer voltage, there will be no danger of subjecting the telephones to an excessive current when the alternating-current voltage is applied. Under these conditions, there should be no sound in the telephones. After applying the alternating-current voltage there should still be no sound in the telephones until the direct-current voltage has been diminished to a point where the alternating-current voltage wave "spills over" the direct current, giving the characteristic alternating-current tone. The position of the slider is then adjusted so that silence is just attained, and at that instant the voltmeters are simultaneously read. Two sets of readings should be thus taken, one for one value of the alternating-current voltage and the other for, say, one-fourth of that value. The quotient obtained by dividing the difference between the two direct-current voltmeter readings by the difference between the two alternating-current voltmeter readings is the ratio of the peak to the root-mean-square voltage.

The reason two sets of readings must be taken is that there is a zero correction to be dealt with. If the single-pole switch on the transformer secondary be thrown to the position where no alternating-current voltage is included in the measuring circuit, it will be found that, with the potentiometer set for zero direct-current voltage, the telephones indicate a "spill-over" somewhat similar to that previously mentioned, and that a definite setting of the potentiometer is required for silence. For the apparatus I use the value of the direct-current voltage required for silence—i.e., the zero correction—is 2.9 volts. One of the two sets of readings mentioned above may be that for zero alternating-current voltage from the transformer; that is, it may be the zero correction. But the setting for zero correction appears to be less sharp than that when an alternating-current voltage from the transformer is included in the measuring circuit. The zero correction may be eliminated by introducing into the circuit a permanent direct-current voltage of a value sufficient to cut out the zero spill-over. If this is done, only one set of readings is necessary. But this expedient introduces a complication that is hardly worth while. The cause of the zero spill-over is, presumably, the stream of electrons thrown off by the filament of the tungar—due to its temperature—independently of any voltage impressed between plate and filament. The method of differences eliminates the effect of it.

The sensitiveness of this scheme of measurement depends not only upon the sensitiveness of the telephones, but also upon the magnitude of the total resistance of

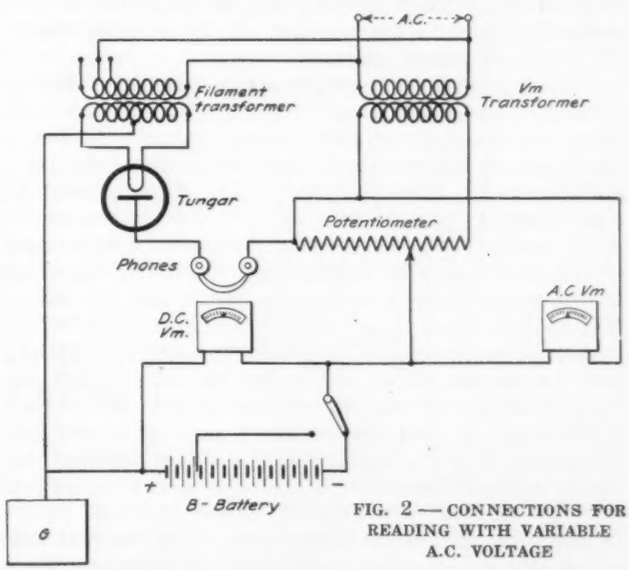


FIG. 2—CONNECTIONS FOR READING WITH VARIABLE A.C. VOLTAGE

the circuit relative to the resistance of the telephones. It is advantageous, therefore, to keep the resistances—especially that of the potentiometer—low relative to the resistance of the telephones. I am using a tungar rated at 2 amp., a pair of telephones having a resistance of 2,000 ohms and a potentiometer having

a total resistance of 284 ohms. With this equipment it is easily possible, in quiet surroundings, to make settings to less than 0.2 volt. This setting is practically independent of the magnitude of the peak measured, so that the greater the peak the lower the percentage error due to setting. If greater accuracy is desired, or if the surroundings are noisy, an amplifier may be used in connection with the telephones. This has been done in taking measurements in a noisy power station.

If the filament transformer secondary has no middle tap and no balance coil or suitable resistance is available for use in parallel with the filament to get at the middle point of the filament voltage, connection may be made to the filament terminal. But in such case two values of the peak must be obtained, one with connection to one terminal of the filament, the other with connection to the other terminal. The mean of the two values so obtained is the value to be taken. The filament voltage should be that for which the tungar is designed, though a considerable variation appears to be permissible without resulting error.

An indicating instrument may be used, instead of a telephone, to indicate a balance, but it must be a very sensitive one to get equivalent results, as a tungar passes a very small current for a pressure of less than 10 volts or 12 volts. A less sensitive instrument may be used, but in such case there will have to be added to the readings of the direct-current voltmeter the previously mentioned 10 volts or 12 volts, the exact amount to be added to be determined from a d.c. voltage-current curve previously taken on the tungar employed.

A ground is shown between the filament of the tungar and the rest of the apparatus. This ground is not absolutely necessary, but the telephones are quieter with it. If there is a ground in one of the elements of the circuit —as in case the direct current for the potentiometer is obtained from a grounded supply system—the position of that element in the circuit should be such as to bring the ground between the connection to the filament and the telephone, preferably between the filament and the rest of the apparatus, as shown. The ground should *not* be between the plate terminal and the telephone, as that connection impairs the accuracy of the scheme, mainly through making the telephone noisy.

Fig. 2 shows a modification of the scheme of Fig. 1. In Fig. 1 the alternating-current voltage is kept constant and the direct-current voltage varied. In Fig. 2 the direct-current voltage is kept constant and the alternating-current voltage varied. The former must be used when no current may be drawn from the source whose peak is to be measured. The latter may be used when current may be drawn from the source on which measurement is to be made. The latter has the advantage that if no source of direct-current suitable for use with a potentiometer is available, a radio "B" battery may be carried along and made use of. It has the further advantage that the voltage of the "B" battery is constant, so that simultaneous reading of the two voltmeters is not necessary and a single observer can obtain accurate results. If the open circuit voltage of the "B" battery is accurately known and can be depended upon to remain constant, the direct-current voltmeter may be omitted. But if the "B" battery cannot be so depended upon and its voltage must be measured, the direct-current voltmeter should be left on the battery at all times while measurements are being made; otherwise an error will be introduced due to the internal resistance of the battery and the consequent difference in its terminal voltage when the voltmeter is on and off.

At first the endeavor was made to check up the scheme by substituting for the alternating-current voltage a direct-current voltage periodically applied by opening and closing a switch. It was found that results obtained in this way were not always correct—that one could, under some circumstances, get a click in the telephone when there should be a balance. This is probably due to leakage or capacity paths between different parts of the circuit or between them and ground. These paths may be such that on closing the switch there will be an adjustment flow of current through the telephones, even when the voltages balance each other around the path of the measuring circuit. This effect does not enter to produce any error when the scheme is used in the regular manner. For in that case the circuit is opened and closed—when it is opened and closed at all—by the tungar. And, inasmuch as an opening is an indication of lack of balance, any accentuation of the effect due to opening and closing is desirable rather than detrimental. If a small alternating-current voltage be added to the direct-current test voltage, the circuit will then be opened and closed by the tungar, instead of by the switch, and readings taken after the manner previously described will check with those taken directly on the direct-current test voltage.

In making measurements at frequencies so high that they will not of themselves produce an audible indication in the telephone, the expedient just described should enable one to obtain accurate results. In such case, one would add to the high-frequency voltage a small voltage of audible frequency and take measurements after the manner previously indicated.

In the case of transient voltages that are reproducible at will, it should be possible to get accurate results by alternately setting the potentiometer and producing the transient until a balance is obtained.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Glove-Testing Equipment

To the Editors of the ELECTRICAL WORLD:

With regard to the glove-testing equipment used by Blackstone Valley Gas & Electric Company, described by E. E. Nelson on page 98 of the ELECTRICAL WORLD of Jan. 12, attention should be called to two points:

1. The last transformer in the series of five will have a potential difference of 10,000 volts developed between one end of its high-tension winding and the low-tension winding if the latter is grounded, as is presumably the case. This voltage is equal to the maximum test voltage for transformers of its rating as prescribed in Rule 6361 of the American Institute of Electrical Engineers Standards. Moreover, this test voltage is to be applied to the transformer for only sixty seconds according to Rule 2355. It thus appears that by using a group of distribution transformers in series the insulation will be repeatedly subjected to an extremely severe strain.

2. The duration of the application of the given test voltage to the gloves is only one-third as long as is tentatively recommended by the A.S.T.M. in *Proceedings*, Volume 22, Part I, on page 937. G. F. WITTIG,

Assistant Professor of Electrical Engineering.

Yale University,
New Haven, Conn.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Evaluating Transformer Losses

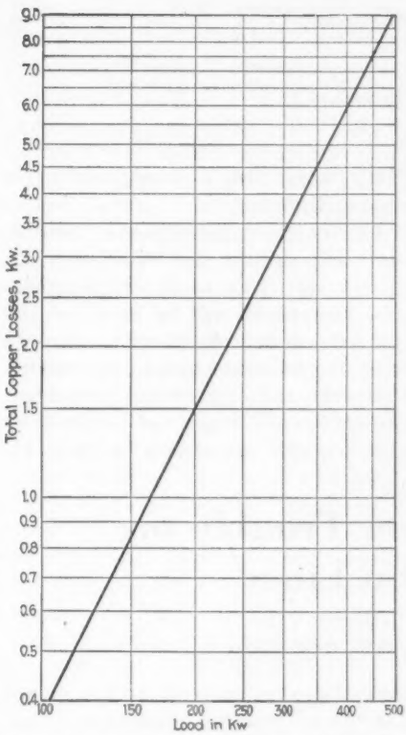
By E. S. Zuch
Pennsylvania-Ohio Power & Light Company, Youngstown, Ohio

In cases where transmission-line voltage is supplied to a power consumer it is sometimes desirable to meter the consumer's load on the low-tension side of the power transformers, because the instrument transformers required are more rugged and reliable for low-tension voltage than they are at transmission-line voltages of 22,000 and 66,000; moreover, the equipment is much less expensive. When the metering is accomplished on the low-tension side of the transformers, correction must be made for the transformer losses. A method of estimating these transformer losses is outlined below.

Large power transformers as a rule are carefully tested at the factory for both iron and copper losses. Consequently, for a particular bank, the manufacturer is asked to supply the test data for these losses. The iron losses are then evaluated with accuracy, using the average of 730 hours per month.

The test data of copper losses are then plotted as shown in the accompanying illustration on logarithmic paper so that a straight line results. These losses are evaluated by the following method. The loss in kilowatt-hours corresponding to the maximum demand registered by the demand meter for the month is taken from the curve of total copper losses. The copper loss in kilowatt-hours is then multiplied by the hours' use of the demand for that month. For example:

Total iron loss: kw. = 3.066.
Total iron loss:
kw.-hr. = 3.066 × 730 = 2.238.
Assumed maximum demand:
kw. = 300.
Monthly consumption:
kw.-hr. = 90,000.
Copper loss from curves:
kw. = 3.3.
Hours' use of demand =
90,000 ÷ 300 = 300.



TOTAL COPPER LOSSES OF TWO 150-KVA., SINGLE-PHASE, 60-CYCLE, 22,000/2,305-VOLT TRANSFORMERS

Total copper loss:
kw.-hr. = 3.3 × 300 = 990.

This method is not strictly correct for all loads. It is, however, correct for a 100 per cent load factor and 100 per cent power-factor load, and since it is based on the kilowatt load rather than the kilovolt-ampere load, it has been found that the percentage of error is small for loads giving less than 100 per cent monthly load factor.

Stopping Electric Hoist Car at Desired Point

By G. A. Seaman
University of Colorado, Boulder, Col.

The problem of bringing an electric hoist to a stop at the desired place is one which is frequently encountered at mines, smelters and factories. Many times the hoist is so arranged that the car automatically dumps itself near the sheave wheel at the end of the track. If the car goes too far, it will break the sheave wheel. If the car does not go quite far enough, it will not dump.

This problem was solved at a large smelter in Colorado in the following way. The position of one of the front wheels on the track was marked when the car was in dumping position. At this point a ½-in. hole was bored down through the rail. A hard-wood plug 1 ft. long was fitted loosely into this and held in place by a spring so that its top projected ½ in. above the rail. A contact was placed on the bottom of this plug connected with a solenoid in such a manner that the motor circuit would be opened when the plug was depressed. By this arrangement the motor circuit was always opened and the car stopped at the desired point.

Estimated Cost of Station and Switch House

The accompanying engineering estimate of the cost of equipment and construction of a transformer terminal switch house was recently prepared as a part of an interconnection development in the East. The work includes a 13,200-volt indoor-distribution switch house and an outdoor substation designed to receive energy at 115,000 volts with an initial installation of 15,000 kva. in transformers. The distribution switch house is to be of brick, steel and concrete, two stories high, and about 33 ft. wide by 70 ft. long. The lower floor will contain a sixty-cell storage battery, charging set, air compressor and locker room, a 13,200-volt bus in a masonry struc-

TABLE I—ESTIMATED COST OF SWITCH HOUSE

Story heights—11.5 and 13.5 ft.; basement for heating plant about 15 ft. x 33 ft. x 12 ft.

Building	$50,115
Switchboard and wiring	142,580
Auxiliary equipment	2,000
Engineering	14,500
Services of construction engineers	24,545
Office at works	5,500
Inspection and expediting	1,500
Insurance	3,000
Temporary construction	5,000
Depreciation on construction equipment	1,500
Contingencies	19,760
Total	$270,000

ture and cable vaults for underground lines. The second floor will house a switchboard, cell-mounted oil circuit breakers, current and potential transformers. A heating plant will be installed in the basement below the station service room. Equipment will be provided for ventilating the 13,000-volt compartments in summer and heating them in winter, and fire escapes will be installed for emergency exits from the 13,200-volt bus and oil-circuit-breaker galleries. Twelve incoming and outgoing overhead three-phase, 13,200-volt circuits with one oil circuit breaker each will be provided with provision for eight of these feeders leaving underground. There will also be one underground circuit from the 13,200-volt side of the transformers in the outdoor terminal station, with two oil circuit breakers per circuit. There will be one circuit for bus-tie service with one oil circuit breaker and 220-volt service for power (three-phase) and 220/110-volt single-phase service for station lighting.

TABLE II—ESTIMATED COST OF 15,000-KVA. OUTDOOR TRANSFORMER STATION

Duct line	$1,000
Manholes	1,650
Yard work	1,850
Equipment foundations	7,725
Three 5,000-kva., 66,000/115,000/13,200-volt oil-insulated self-cooled outdoor transformers	51,200
Switchgear and wiring	53,005
Auxiliary equipment	1,750
Preliminary operation	500
Building (transformer repair house)	5,000
Engineering	5,500
Construction engineers	15,275
Office at works	4,000
Inspection and expediting	1,000
Insurance	1,500
Temporary construction	2,500
Depreciation on construction equipment	1,000
Contingencies	13,545
Total	$168,000

The outdoor transformer substation will occupy an area approximately 150 ft. x 45 ft. Galvanized-steel structures will be used for the support of equipment and concrete mats for column bases, oil circuit breakers and lightning arresters. The principal items of equipment and structure are shown in Table II.

Prevention of Sleet Trouble on High-Tension Lines

BY GEORGE S. DIEHL
Chief Operator Highlandtown Substation,
Pennsylvania Water & Power Company, Baltimore

IN THE issue of the ELECTRICAL WORLD for March 10, 1917, page 452, R. L. Thomas discussed the nature of sleet troubles on lines described and told of the operating methods used by the Pennsylvania Water & Power Company to overcome these troubles. Since then several improvements from an operating standpoint have been made in the methods followed.

Highlandtown, the Baltimore substation, is 40 miles from Holtwood, Pa., the generating station. At present there are four circuits between these two stations, and all conductors are 300,000-circ.mil nineteen-strand aluminum cable. There are also two No. 0 seven-strand copper circuits from Holtwood to Lancaster, which is 14.7 miles. The elevation of the lines varies from 50 ft. above sea level at Highlandtown to 600 ft. at Holtwood and about 1,000 ft. at Lancaster. The transmission voltage is 70,000.

When the weather conditions are favorable for sleet or wet snow the patrolmen and substation operators report hourly to the Holtwood operator regarding the local conditions of the weather and sleet. Test cables the same size as circuit conductors are installed at each of the five patrol stations so that all information concerning sleet formation may be given on a uniform basis.

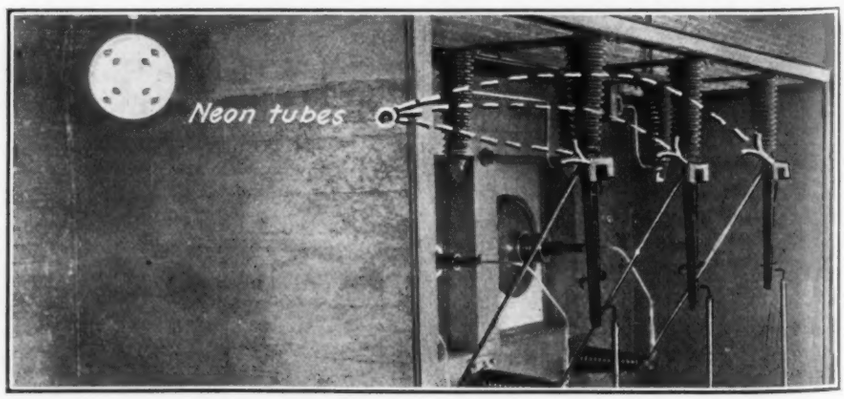
When sleet is reported forming by any patrolmen on the Baltimore system two circuits are taken out of service and the load is carried on the remaining two. One of the two circuits cut out remains idle and the other is prepared for a heat run, which consists of the application of sufficient current to the circuit to melt the sleet on the conductor. The circuit is first disconnected from the system, then all three conductors are grounded at Highlandtown, and the circuit is connected to the special sleet bus at Holtwood. An 11,000-volt generator is separated from the system and connected to this bus. Normally from 360 amp. to 385 amp. is required to melt the sleet on the lines. A heat run is maintained on a Baltimore circuit for forty minutes, as will be noted in the accompanying schedule, which also shows the method of rotating the heat run on each of the four circuits.

The load carried at normal power factor on the two circuits in service is frequently enough to keep the sleet from forming on them. If the line load is below 300 amp., an effort is made to redistribute the wattless current so that the line amperage will be above 300.

To overcome the possibility of the failure of telephone lines during a sleet storm, a chronological sequence of operation has been so arranged that once the heat runs are started they may continue indefinitely until communication is again established. It will be noted in the tabulation that no reference is made to "a.m." or "p.m." and that no two switching operations are in process at one time. It is very essential that the clocks be checked between stations. Provision is also made for instructions to each operator to continue heat runs in the event of the failure of the circuit.

Carrier-current telephone equipment has now been operating successfully between Holtwood and Highlandtown for a number of months, but it is quite probable that the schedule of operation without communication will be continued this year.

For the benefit of the Highlandtown operator two very reliable telltales have been provided. A 300/5-amp. current transformer has been installed in the sleet-bus ground cir-



NEON TUBES USED FOR DETECTING LIVE CIRCUITS

SEQUENCE OF OPERATION FOR MELTING SLEET ON TRANSMISSION LINES

Circuit No.	Circuit Out	Line Disk Open	Sleet Bus Disk Closed	Heat On	Heat Off	Sleet Bus Open	Line Disk Closed	Circuit Closed In
Three Circuits								
1	12:05	1:06	1:08	1:10	1:50	1:55	1:57	2:00
2	2:05	2:06	2:08	2:10	2:50	2:55	2:57	3:00
3	3:05	3:06	3:08	3:10	3:50	3:55	3:57	4:00
1	4:05	4:06	4:08	4:10	4:50	4:55	4:57	5:00
etc.								
Four Circuits								
1	8:05	8:06	8:08	8:10	8:50	8:55	8:57	9:00
2	8:05	9:06	9:08	9:10	9:50	9:55	9:57	10:00
3	9:05	10:06	10:08	10:10	10:50	10:55	10:57	11:00
4	10:05	11:06	11:08	11:10	11:50	11:55	11:57	12:00
1	11:05	12:06	12:08	12:10	12:50	12:55	12:57	1:00
etc.								

cuit of each line. The secondary of each of these current transformers is connected to a bank of eight 6-volt, 8-cp. automobile headlight lamps, which are connected in parallel and mounted on a white disk that indicates when there is current in the sleet bus. The lamps are colored red to attract attention. Four lamps are sufficient, but eight are used to insure a factor of safety, and in addition resistance is paralleled across the lamps in case all burn out. This has proved a very valuable indication in our sleet-prevention plan. The target and current transformer are shown herewith.

As the circuits are not equipped with 70,000-volt potential transformers, in order that the operator may know whether the circuit is alive or not a neon tube (Commercial Spark C) has been utilized to detect potential. The tubes will glow just as well on 70,000 volts as they will on low voltages if they are mounted correctly. They were tested to find out whether they would glow if the conductor to which one was connected was clear of potential and the other two conductors of a three-phase circuit were energized. It was found that the one on the conductor that was clear of potential would not glow. Several combinations were tried, but the tube could not be made to give a false indication unless it had burned out. This was such a simple and inexpensive way of detecting potential that the use of the tubes was made general. Two tubes have been under test for eighteen months and are still "O.K." They have stood up under lightning surges and bus flashovers.

Each phase of a 70,000-volt circuit, ahead of all disconnectors, is equipped with a "Spark C" mounted in a box-like container with a white border on it to attract attention. This has been of considerable assistance to the operator, especially during times of trouble.

It has been necessary to depend upon rural telephone service between Holtwood and the Engleside substation in Lancaster. During sleet storms no dependence can be placed on this line. A set of signals is used between these stations regardless of whether telephone service can be used or not. The signaling is done by the Engleside operator, who has charge of the Holtwood-Lancaster circuits. When the weather is favorable for sleet the Holtwood operator keeps a close watch on the Lancaster circuit meters. The signaling is as follows: Either circuit may be used, but No. 3 will here be used as an example. Signaling always starts on the hour. If Holtwood should miss the signal, a second attempt would be made half an hour later. Engleside prepares for signaling by paralleling the circuits on the low-tension side. Example:

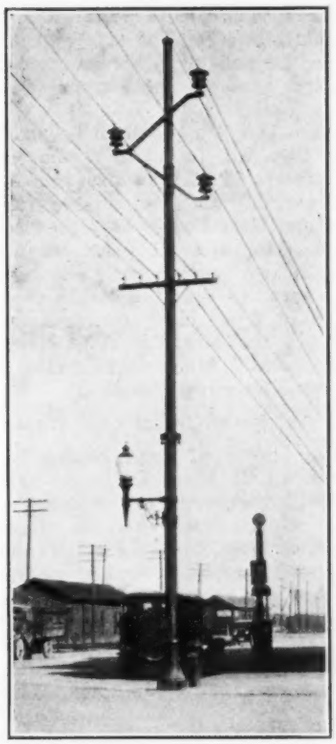
1:00 a.m.—Engleside cuts out No. 3 circuit—load off.
1:01 a.m.—Engleside closes in No. 3 circuit—load on.
1:02 a.m.—Engleside cuts out No. 3 circuit—load off.
1:04 a.m.—Holtwood cuts out No. 3 circuit—no potential at Engleside.
1:05 a.m.—Holtwood closes in No. 3 circuit—potential at Engleside.
1:06 a.m.—Holtwood cuts out No. 3 circuit—no potential at Engleside.
1:15 a.m.—Holtwood tests for voltage, opens disconnectors and closes ground disconnectors. (Between 1:06 and 1:15 a.m. Engleside has been opening disconnectors on No. 3 circuit.)
1:20 a.m.—Engleside places heat current jumpers on No. 3 circuit.
1:30 a.m.—Engleside closes No. 3 circuit in on heat current bus.
2:00 a.m.—Engleside cuts heat current off No. 3 circuit and removes jumpers.
2:10 a.m.—Holtwood removes grounds from No. 3 circuit.
2:20 a.m.—Holtwood closes in on No. 3 circuit with normal voltage and Engleside restores circuit normal as soon as possible.

At Engleside a special transformer is provided for supplying heat current. It is connected to the Engleside 2,300-volt bus and is connected for 3,800 volts on the high-tension side. About 240 amp. is maintained on these circuits.

The success of these or any other methods for preventing sleet troubles depends upon getting started before sleet gains headway and upon close co-operation by all concerned.

Neat High-Voltage Lines Through Cities

AN EXAMPLE of what can be done to make high-voltage transmission lines appear less unsightly in cities and towns is shown in the accompanying illustration. This is the type of 66,000-volt line construction used by the Southern Colorado Power Company in La Junta, Col., and other towns on its lines.



ORNAMENTAL STREET-LIGHTING BRACKETS ON POLES ADD TO APPEARANCE OF LINE ON CITY STREETS

Tubular wrought - iron poles, standing 50 ft. above the sidewalk, provide a maximum of strength while taking a minimum of space. A channel-iron wishbone carries the 66,000-volt circuit while distribution circuits are carried on standard wooden crossarms. Ornamental street-lighting brackets give a pleasing effect both by day and night. Construction of this type should do much to elminate the objection to high-voltage lines passing along city streets where this is necessary.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Locating, Setting and Span Length of Pole Lines

Location of Pole Lines.—On public thoroughfares poles shall be placed on the side which is most free from foreign lines, and, in general, the same side shall be used throughout the length of the line. If other sections of the company's lines are on the same road as the line to be built but some distance away, the new poles shall be placed on the same side of the road as that occupied by the majority of the poles. If there is a foreign line along the road dodging from one side to the other, the general superintendent shall be advised and he will attempt to make arrangements with the other company to leave one side of the road free. In general, it is bad policy to cross a road to avoid trees or other obstacles.

Poles in any town shall be placed so that they will be on the same side of all streets as far as practicable; for example, all poles on streets running east and west should be placed on the north side, and all poles on streets running north and south on the west side, so as to keep the length of spans standard from block to block and to simplify the construction at street intersections. Alley construction shall be used wherever feasible.

ADJUSTING LENGTH OF SPANS

The length of span should be adjusted so as to make poles come in line with property lines or fences where practicable. Poles shall be placed as nearly as possible to the satisfaction of adjoining property owners where objections are raised. Special care must be taken not to place poles where they will interfere with gates, driveways, windows, porches, coal chutes, etc. In special cases poles may be placed on property lines within the interior of blocks not having alleys to distribute to houses from the rear, but primary circuits must be kept off of all such poles.

Poles in rough country should be placed so far as possible so as to avoid upstrain on the insulators by the conductors. It is usually advisable to increase the length of span so as to avoid such upstrain.

Pole Setting.—Any permits required by the authorities covering location of poles or digging of holes in streets or along highways must be obtained before digging any holes. Approved right-of-way agreements must be signed for all poles set on private property.

In normal firm ground poles shall be set to a depth specified in Table IV. In solid rock poles may be set to one-half of the depth given in Table IV, but never less than 3½ ft. A pole to be set in soft ground may be set in a barrel worked into the hole. The barrel should be filled with concrete or small stones so as to make the pole secure.

When exceptional stability is required, an artificial foundation of concrete may be placed around the base of the pole, extending at least 1 ft. from the pole on all sides and 3 in. above the ground level and beveled to shed water. The mixture shall consist of one part portland cement, two and one-half parts sand and five parts broken stone and clean gravel. The mixture when placed shall contain enough water to make it flow freely and take its place without tamping. The pole shall be solidly braced in position and such bracing left until the concrete is hard.

Poles which must be set in mine

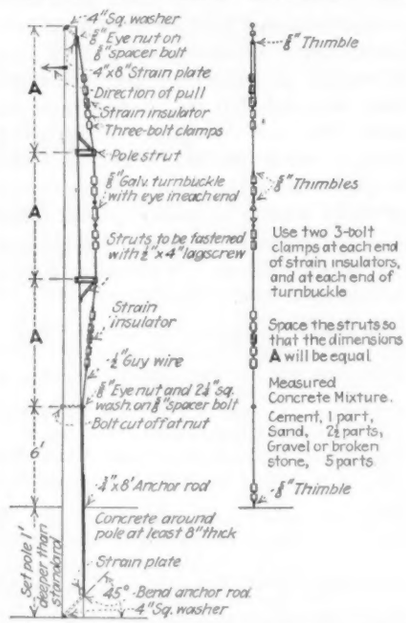

4"Sq. washer
⅝"Eye nut on ⅝"spacer bolt
4"x6"Strain plate
Direction of pull
Strain insulator
Three-bolt clamps
Pole strut
⅝"Galv. turnbuckle with eye in each end
Struts to be fastened with ⅜"x4"lagscrew
Strain insulator
½"Guy wire
⅝"Eye nut and 2½"sq. wash. on ⅝"spacer bolt
Bolt cut off at nut
6'
4"x8'Anchor rod
Concrete around pole at least 8"thick
Strain plate
45°
Bend anchor rod
4"Sq. washer
Set pole 1' deeper than standard
A
A
A
⅝"Thimble
⅝"Thimbles
Use two 3-bolt clamps at each end of strain insulators, and at each end of turnbuckle
Space the struts so that the dimensions A will be equal
Measured Concrete Mixture. Cement, 1 part, Sand, 2½ parts, Gravel or broken stone, 5 parts
⅝"Thimble

FIG. 4—TRUSSED-POLE CONSTRUCTION ALLOWABLE ONLY WHEN NORMAL GUYING CANNOT BE USED

dumps which are or may be on fire shall have concrete as above placed around the sides as well as bottom of the pole and extending 12 in. above the surface.

In exceptional situations, as on heavy corners in cities, where guying is impossible and ordinary crib bracing will not hold the strains or cannot be used, trussed poles, such as shown in Fig. 4, set in concrete may be used. Slack spans shall be used on both sides of such trussed pole. This form of construction shall be used only when approved by the distribution engineer.

At poles set in sidewalks a space of 2½ in. must be left free of concrete around the base of the pole. Agreements may be made with city engineers to accomplish this end.

All holes shall be dug large enough to admit a tamping bar all around the pole and shall not have a larger diameter at the top than at the bottom. Poles shall be set to stand perpendicular when the line is completed so that no pole shall be more than 2 in. out of line with the others. Poles at line terminals, angles and other points of abnormal stress shall be given a slight rake against the direction of the stress. Poles with a bend shall be placed with the bend in the direction of the line.

Adjacent poles shall be set with gains facing in opposite directions. Poles next to corners shall face the corner. In case of crossings, long spans, etc., poles on each side shall be faced toward such special construction. Poles immediately preceding end poles shall be faced toward the end of the line.

METHOD OF TAMPING POLES

After a pole is in position only one shovel shall be used in filling the hole, while three tampers continually tamp until the hole is completely filled. When available small-sized rock should be used in the filling. Poles shall be inspected after they have been subjected to a heavy rainstorm and any of the fillings that have sunk shall be refilled.

Protection.—If a pole must be set in such location as to be exposed by traffic to abrasions or other damage which would affect its strength, a guard shall be installed. All poles shall be kept free from posters, signs, tags or other foreign material, except where street signs or mail boxes are permitted on poles by franchise requirements.

TABLE IV—SPECIFIED DEPTH FOR SETTING DISTRIBUTION POLES

Length Over All, Ft.	Straight Lines	Curves, Corners and Points of Extra Strain
30	5 ft. 0 in.	5 ft. 6 in.
35	5 ft. 6 in.	6 ft. 0 in.
40	6 ft. 0 in.	6 ft. 6 in.
45	6 ft. 6 in.	7 ft. 0 in.
50	7 ft. 0 in.	7 ft. 6 in.
55	7 ft. 6 in.	8 ft. 0 in.
60	8 ft. 0 in.	8 ft. 6 in.
70	8 ft. 6 in.	9 ft. 0 in.

Span Length.—In cities and towns the length of span shall be such as to fit the length of blocks, and poles at street intersections shall be placed so that they will be in line with other poles on intersecting streets. For poles carrying weatherproof copper wire the normal spacing shall be 110 ft. to 150 ft. For poles carrying bare copper wire the normal spacing shall be from 150 ft. to 250 ft. outside of city or borough limits.

Line Level.—The length of poles shall be so proportioned to the contour of the ground or to adjacent poles of exceptional height set to clear obstacles that the difference between the level of the wires on adjacent poles where practicable shall not be more than 5 ft., except during reconstruction periods, when 10 ft. will be allowable.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Comparison of Residential Energy Consumption

FROM the comparison sheets of a group of six central-station companies in the East the accompanying tabulation is given of the energy consumption per residence customer for the eleven months ended Nov. 30, 1922 and 1923, and for the months of November, 1922 and 1923. The kilowatt-hours per capita for residential service is also shown. The gains in kilowatt-hours per residential customer for eleven months of 1923 ranged from 2.9 to 10.5 per cent and the residential kilowatt-hour per capita for this period ranged from 28.6 to 55.1. The company with the best showing, company "B," has lately put into effect a residential rate with a low energy charge combined with an initial charge proportioned according to the size of the customer's establishment. The November figures show a general increase in the use of electricity over the corresponding month of the previous year.

KILOWATT-HOUR CONSUMPTION PER CUSTOMER AND PER CAPITA

	Totals Eleven Months					November					
Company	1922	1923	Gain, Kw.-Hr.	Per Cent	1923 Kw.-Hr. per Capita (1920 Census)	1922	1923	Gain, Kw.-Hr.	Per Cent	Nov., 1923 Kw.-Hr. per Capita (1920 Census)	Ratio of Population to Residence Customers
A	292.4	308.4	16.0	5.5	30.9	34.1	34.2	0.1	0.3	3.9	8.7 to 1
B	253.2	279.9	26.7	10.5	55.1	30.1	32.6	2.5	8.3	6.9	4.5 to 1
C	263.7	272.8	9.1	3.5	45.8	29.5	32.6	3.1	10.51	5.9	5.5 to 1
D	229.5	249.2	19.7	8.6	35.3	27.6	30.5	2.9	10.1	4.9	6.2 to 1
E	200.0	205.8	5.8	2.9	28.6	20.9	23.6	2.7	12.9	3.4	6.9 to 1
F	230.4	244.6	14.2	6.2	47.3	26.2	28.7	2.5	9.5	5.9	4.8 to 1

Range and Heater Revenue $9.18 per Month

AN ANALYSIS of 473 electric range and water-heater accounts on the lines of the Washington Water Power Company for the month of March, 1923, showed the results given below.

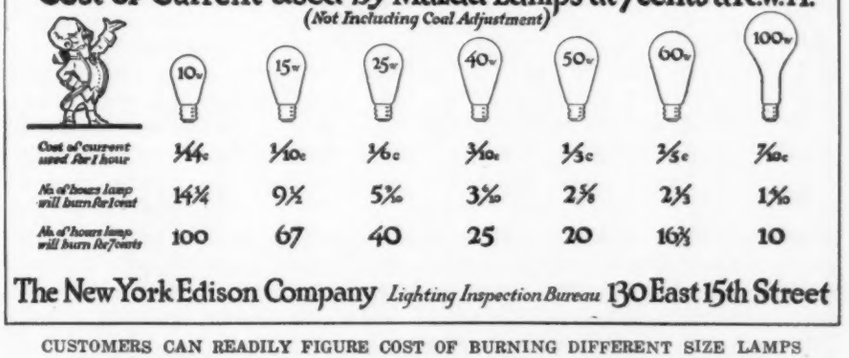
The accounts used were selected at random and represent about 10 per cent of the total number of range and water-heater accounts.

Number of accounts taken	473
Kw.-hr. per month	48 to 756
Average kw.-hr. per account	195
Average monthly range bill	$6.65
Average monthly water-heating bill	$2.53
Total average bill for all service used	$9.18

Chart Shows Low Cost of Using Electric Light

TO ENCOURAGE a more liberal use of energy for illumination the lighting inspection bureau of the New York Edison Company is distributing a useful piece of advertising in the form of a blotter showing how little it costs to burn electric lights. The graphic diagram reproduced here enables a customer to tell at a glance the exact cost of operating different sizes of incandescent lamps at the company's 7-cent rate. On it the cost of energy per hour and the number of hours a lamp will burn for 1 cent and 7 cents have been worked out for the 10-watt to 100-watt sizes.

Although the chart has been figured on a 7-cent rate, not including a coal adjustment charge one-half cent additional, it could very easily be adapted to any other rate.



CUSTOMERS CAN READILY FIGURE COST OF BURNING DIFFERENT SIZE LAMPS

Detroit Edison Exchanges Cords Free of Charge

AS A CONVENIENCE to customers whose electrical appliances will not operate because of cord trouble the Detroit Edison Company keeps on hand in all of its offices a stock of flatiron cords fitted with "Standard" or "Fitsall" terminals. Any customer may exchange a cord which is out of repair for a good one. Miss S. M. Sheridan, vice-president and sales manager of the company, in explaining this practice says:

"There is no charge or formality connected with this exchange. The customer turns in one cord and receives another. If a repair man calls at a house and finds that the iron is not working owing to a defect in the cord, he puts on a cord that will work. The one that is out of order is turned in at our shop and put in order. So long as any part of the cord itself or its terminal parts may be salvaged we will exchange it for one that works. We use the good parts for repairing.

"As we take in any cord without question, it is necessary to sterilize the actual cord that is to be put in service again. This practice means, of course, that our stock must be constantly supplied with new cords. These new cords we also make up in our own shop. It requires about 3,000 new cords to take care of 86,034 renewals, which were handled in ten months of 1923."

Twelve Months' New-Business Schedule of the Public Service Electric Company Results in 50 per Cent Increased Sales

Appliance	January	February	March	April	May	June	July	August	September	October	November	December
Irons	Campaign on flat irons at $5.90	Campaign on electric irons at $1 a month	Campaign on electric irons at $5.90	No special offer adv. in newspaper	Campaign on electric irons at $1 a month	Campaign on special iron at $4.50	Adv. all electric irons		Campaign on electric irons at $5.90	Campaign on electric irons at $1 a month	Adv. all electric irons at regular prices	Adv. all three irons at regular prices
Toasters, grills and table stoves and toaster-grills	Adv. special on toaster one week	Adv. special on grill one week	Adv. special on table stove one week	Adv. group one week regular prices	Adv. special on grills one week	Adv. special table stove one week	Adv. special toaster grill one week			Special on table stove one week	Feature all Xmas gifts, regular prices	Same
Waffle irons*	Feature in adv. one week	Same	Same			Feature in adv. every week				Feature in adv. every week	Feature for Xmas gifts	Same
Percolators	Feature one week	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same
Small stoves	Feature in adv. one week	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same
Heating pads, vibrators, immersion heaters, water cups	Feature group in adv. one week for health	Same	Same	Same						Same	Same	Same
Hair dryers, curling irons, vibrators	Feature group in adv. one week for beauty	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same
Radiators	Feature in adv. one week	Same	Same	Feature in adv. each week	Close out at special price					Feature in adv. each week	Feature in adv. one week	Same
Sewing-machine motors			Feature in adv. one week.	Same	Same				Same	Same	Same	Same
Vacuum cleaners	Adv. during first week	Adv. two weeks	Adv. two weeks	Campaign broadside, special terms	Adv. two weeks	Same	Summer campaign broadside, special terms, prizes to salesmen		Adv. two weeks	Campaign broadside special terms	Feature in adv. each week	Same
Washers	Campaign broadside-special terms	Feature in adv. one week	Same	Same	Campaign broadside special terms	Feature in adv. one week	Same	Same	Campaign broadside special terms	Feature in adv. adv. one week.	Feature in adv. each week	Same
Ironers	Feature in adv. one week	Campaign broadside—special offer	Feature in adv. one week	Same	Same	Campaign broadside special offer	Feature in adv. one week	Same	Same	Same	Campaign broadside special offer	Feature in adv. two weeks
Lamps	One small adv. each week featuring a special lamp	Same	Same	Same featuring summer lamps	Same	Same			Same featuring a special lamp	Same	Same	Same
Electric cookers†	Feature in adv. one week	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same
Kelvinators	Letters and folders followed by men	Same	Same	Same	Same and feature in adv. each week	Same	Same		Letters and folders followed by men	Same	Same	Same
Industrial appliances‡												
Fans					Adv. and display last two weeks	Adv. and display each week	Adv. and display each week	Close out at reduced prices				
Incandescent lamps§												
Violet Ray Generators	Feature in adv. one week	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same

* Demonstrator in principal offices. †Featured in talks before clubs; demonstrated in principal offices. ‡Stickers on power bills featuring a different appliance each month; careful canvass and follow-up by salesmen. §Quality of lamps and delivery service and system of distributing dealers on back of lighting bills; a brief statement of same in all newspaper group advertisements; complete stocks; attractive interior displays.

DEFINITE planning and scheduling of its new business program at the beginning of the year for the ensuing twelve months has been productive of exceptionally good results for the Public Service Electric Company, Newark, N. J. In 1923 electric appliance sales amounted to $1,850,000, an increase of a little more than 50 per cent over the previous year. Such an increase could not have been made, according to F. D. Pembleton, manager of the company's electric appliance department, without the use of the schedule which is shown above.

It will be noted that careful attention has been given to timing special sales and campaigns according to the seasonal demand for the various devices. All advertising is tied in directly with the sales, and the advertising department thus knows well in advance the kind of copy that will be required each month.

Another advantage of laying out the new-business plans so far in advance, particularly in the case of the Public Service Electric Company, is that the local managers in each of the company's six divisions can co-ordinate their efforts and make the most of the general advertising and promotional work. Supplementing this schedule, instructions for conducting new-business work are issued every three months. Monthly and special quarterly meetings of district managers with the executives of the company are held in order that local conditions may be discussed and if necessary plans altered.

A Well Located and Planned Central-Station Salesroom

FAVORABLE store location, standardized store furnishings and a congenial atmosphere to create buying appeal are outstanding features in the new appliance salesroom recently equipped by the Public Service Company of Northern Illinois at Wilmette, a suburb of Chicago. Next to the quality of its service the company believes that convenience of access for customers and attractive surroundings have a large influence on public good will, and therefore considerable thought was given to these questions.

As many of the company's customers commute between Wilmette and Chicago a location was chosen on a prominent corner adjacent to the Chicago & Northwestern Railroad station and the electric interurban lines, thus making it convenient for commuters to step into the store and transact business. The company desired also to standardize a type of salesroom for other towns which it serves and so decided on the style of furnishings illustrated here. Store layout from the standpoint of furniture, color scheme and lighting fixtures was required to conform with the general high standard of the local residential section.

All of the appliance cases, cupboards and counters are finished in silver ash, while the baseboard of the counters is of tile. The counters are built in 6-ft. lengths and are interchangeable, thus increasing their usefulness as compared with the old type of store fixtures which could not well be used elsewhere. Cupboards extend along the wall of the store toward the front and have sixty double compartments, in which are kept the smaller appliances and parts, including wiring material. A sample of the contents of each compartment is placed in front, behind a glass partition.

The cashier's cage is inclosed with plate glass instead of brass gratings. Opposite it an electric fire log is kept burning, and beside the fireplace are two writing desks for the convenience of customers. A plate rail was built around the wall to provide space for carrying sales aids and advertising cards.

Open display windows were installed in order that passersby could readily see the interior of the store, and appliance showcases were placed directly back of the windows. The general illumination of the store is furnished from nine ceiling outlets, while seventy-seven reflectors with 50-watt lamps are used in the various display shelves and showcases. The color scheme of the store is buff with a cream ceiling, and buff window curtains are used.

In designing and equipping this salesroom the Public Service Company of Northern Illinois has aimed to set a standard which can be followed in all of its offices, and as the furnishings have been made in comparatively small units they are interchangeable and can not only be easily moved about on the sales floor but may be readily transferred from one office to another. H. B. Fisk is in charge of merchandising for the company.

LOOKING TOWARD FRONT OF STORE—COUNTER AND COMPARTMENT WALLCASE ON LEFT

REAR OF APPLIANCE SALESROOM, CASHIER'S CAGE AND ELECTRIC FIREPLACE IN FOREGROUND

APPLIANCE AND SHOW-WINDOW CASES, SHOWING EFFECT OF ILLUMINATION AT NIGHT

What Other Companies Are Doing

Spokane, Wash.—A banquet was given by the Washington Water Power Company to its salesmen on Dec. 28 in appreciation of the records made during 1923 in the sale of electrical merchandise. The sales for the year as compared with those for 1922 were nearly doubled. Officials of the company expressed their belief in electrical appliances as revenue builders and outlined the company's development program for 1924.

Grand Rapids, Mich.—To show prospective customer-stockholders the extent of its properties and the nature of the territory served the United Light & Railways Company has recently completed a motion-picture film which features a number of the company's generating plants in Iowa. A great many scenes taken in different manufacturing plants using power from the company's line are included in the picture. As these industries are widely diversified, the showing of the picture in the cities and towns served by the company should help to dispel the idea that the community is dependent largely upon agriculture or one or two single lines of manufacture.

Providence, R. I.—House wiring contracts secured in the 1923 campaign of the Narragansett Electric Lighting Company totaled $434,600, compared with $370,351 for the year previous, the number of meters involved being respectively 4,982 and 4,294. The number of contracts placed in 1923 was 2,742 against 2,373 for 1922.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Hydro-Electric Development and Steam Equipment

Hydro-Electric Plant at Raanaasfoss.—W. HOLLIGER.—This paper gives an interesting account of the design and erection of a modern Norwegian low-head water-power plant. On account of the extreme variation of the volume of water carried by the river (220 cu.m. to 3,000 cu.m. per second) a rather complex dam construction was necessary. The regulating part is of the eccentric-roll type. To insure perfect remote-control operation even during the coldest part of the winter, electric heating units are embedded at the two ends of the dam, where it touches the stationary pillars and where ice formation would be liable to cause jamming. A hydraulic head of about 14 m. is available, which will be utilized by four and ultimately by six 12,500-hp. to 14,000-hp. turbines of the double Francis type. Each turbine is connected to a 50-cycle, 12,000-kva., 107-r.p.m. three-phase generator, the overall diameter of which is 30 ft. A voltage regulation of from 6,400 volts to 7,850 volts is possible. Rotor and stator are made of four parts. The former carries fifty-four poles and was subjected to a speed safety test of 200 r.p.m. As the bulk of the machines is very considerable in proportion to the decidedly small machine-house room, noiseless operation was required and fulfilled by the complete inclosing of the generators. The guarantee tests made in place showed a unity-power-factor efficiency of the generators of 95.8 per cent at a heating considerably below contracted values. A dead short-circuit test was made on one of the generators at overexcitation of 9,000 volts with no detrimental result. Energy is transformed and transmitted at 50,000 volts. —*Brown-Boveri Mitteilungen*, December, 1923.

Generation, Control, Switching and Protection

Dielectric Losses.—M. J. GRANIER.—A report of 150 pages on research work concerning dielectric losses, experimental and theoretical. The author comes to the following conclusions: When a condenser is connected to a source of direct current the principle of superposition cannot be applied to its dielectric if this consists of a commercial insulating material such as impregnated paper. A prolonged application of direct current voltage will improve a number of these insulating materials slowly. A curve giving the relation between charge and voltage shows a cycle similar to the hysteresis cycle. However, the first cycle varies with the frequency, the second does not. The author demonstrates that methods used heretofore to determine this curve were very inaccurate. The losses and the residual charge are proportional to a certain power of the frequency. In a solid and homogeneous body the losses are proportional to a certain power of the temperature. At constant temperature and perfect contact between copper and insulation the loss angle is independent of voltage and of the thickness of the insulation.—Dielectric losses in general are caused by electrolytic impurities.—*Bulletin de la Société Française des Electriciens*, August, September and October, 1923.

Automatic Synchronizer.—H. C. KLONINGER.—The apparatus described consists of an induction-type time-delay relay connected across the machine and the bus to which the machine will have to be synchronized. In order to insure closing of the relay contacts at the proper point another induction relay is added, one coil of which is connected across the machine terminals, the other across the bus. When the machine is not in synchronism with the bus the coils will set up a torque in the disk. This actuates segments which insert resistance in the circuit of the coils of the first relay. This arrangement cuts short the high-current period of the first relay, thus insuring closing of the contacts of this relay just at the moment of synchronism. These contacts close the circuit of the breaker-closing coil.—*Brown-Boveri Mitteilungen*, November, 1923.

Transmission, Substations and Distribution

Calculation of Long Transmission Lines.—M. DARRIEUS.—A diagram for practical use without arbitrary simplifications that can give the actual values in a simple way is developed. The author also discusses the diagrams of Blondel and of H. B. Dwight. In addition, the author shows that if the voltage is kept constant on a line at a sufficient number of points by generators or condensers, the system will be one without reflex wave and of maximum efficiency. In this system the characteristic resistance replaces the voltage as a variable and no-phase displacement will occur under any load.—*Bulletin de la Société Française des Electriciens*, August, September and October, 1923.

Power Limitations of Transmission Systems.—R. D. EVANS and H. K. SELS.—In order to investigate the power limitations of a transmission system it was necessary to rearrange and extend the present method of transmission-line calculations to make them more convenient for the study of the practical limit of maximum power. The method which has been found best adapted for this purpose is a development of the power circle diagram combined with the characteristic curves of the synchronous machines used to regulate the system. This power diagram has been made applicable to all the types of transmission systems by including the transmission line, step-up and step-down transformers, series and parallel circuits, so that the most complex transmission systems may be represented by a single equivalent set of transmission constants. A general discussion of the method of calculation, the maximum power limits, the practical operating limit and illustrated examples is given in Part I of the paper, while the analytical development upon which the discussion is based is given in Part II. This paper will be presented at the midwinter convention.—*Journal of A. I. E. E.*, January, 1924.

Units, Measurements and Instruments

Transformers with Controlled Stress on Insulation.—F. DESSAUER.—Transformers for very high voltages, such as are used for X-ray work and particularly for testing purposes, have hitherto been built as single units, with one winding for the full voltage. Such a design requires a very large amount of carefully placed insulation. In this article the author shows the savings which can be realized if such transformers are built in two or more units, so that high-voltage and low-voltage windings will have a much lower voltage gradient between each other and require accordingly much less insulation. Such a cascading of transformers furnished, for example, absolutely safe and dependable X-ray sets of 5 kva. to 10 kva. output and 160 kv., capable of ten hours' continuous daily operation. On testing transformers for voltages of 200 kv. to 1,000 kv. very considerable savings in the required floor space will also result from using multiple-unit sets. The amount of insulation needed in a transformer increases with the cube of the voltage gradient between primary and secondary windings. A great variety of cascading methods as developed by different designers are shown. Some of these indicate the further simplification possible by the introduction of auto-transformer windings, which, however, necessitates in some cases special short-circuited turns to retain the magnetic flux in its proper path. One concern builds unit transformers for 80 kv. to 90 kv., any number of which may be properly cascaded to give voltages of as high as 500 kv. to ground. The author shows finally voltage flash-over curves for needle and for sphere electrodes, with values consistently 5 per cent above American test values.—*Elektrotechnische Zeitschrift*, Dec. 20, 1923.

Temperature and Pressure Correction Chart for the Sphere Gap.—R. H. MARVIN.—The A. I. E. E. rules for the use of the sphere gap require a correction to be made to the indicated voltage for any variations of either

temperature or barometric pressure from the standard values. The author has worked out a straight-line chart, from which the correction factor may be obtained from any temperature or barometric pressure reading.—*Journal of A. I. E. E.*, January, 1924.

Illumination

Illumination in Relation to Production and in Power Stations.—Two papers given in this issue and that were presented at the annual convention at Lake George may be found abstracted previously in the ELECTRICAL WORLD. The first, "The Relation of Illumination to Production," by D. P. Hess and Ward Harrison, may be found on page 703 of the October 6, 1923, issue. The second, "Salient Features in Power Station Lighting," by Raymond A. Hopkins, may be found on page 913 of the November 3, 1923, issue. The former is a four-page abstract and the latter a two-page abstract. — *Transactions of I. E. S.*, November, 1923.

Development of Electric Light.—H. SCHROEDER.—A historical account of the development of the electric light from Volta's discovery of the principle of the primary battery up to the present time. This eleven-page article covers the entire field very thoroughly, particularly in its description of the modern types of lamps.—*Sibley Journal of Engineering*, December, 1923.

Motors and Control

Modification of Polyphase Induction-Motor Performance.—K. L. HANSEN.—The possibility of obtaining speed adjustment and power-factor correction of induction motors by impressing an electromotive force on the rotor is a subject which has attracted considerable attention in recent years. As compared with the straight polyphase induction motor, the graphical treatment in this case becomes much more involved, if reasonable account be taken of all the phenomena. The analytical treatment of the polyphase induction motor is, however, readily extended to the case where an electromotive force is impressed on the rotor. There appears to be a general impression that in deriving formulas analytically the usual method, based on the rotating magnetic-field theory, is no longer suitable when a voltage is impressed on the rotor, but that it is preferable to resolve the induced electromotive force in the rotor into two components. This paper is an attempt to show that not only is the rotating-field theory still applicable, but that the results can probably be obtained most readily by means of it.—*Journal of A. I. E. E.*, December, 1923.

Advantages of Centrifugal Pump for Coal-Mine Drainage.—G. V. WOODY.—The author considers the several factors involved in determining whether a centrifugal or a reciprocating pump should be purchased for handling the water in anthracite mines. An approximate comparison of the two types is given in the accompanying table. It is made on the assumption of half-time operation and power at 1.5 cents per kilowatt-hour. The economics of automatic operation are also considered.—*Coal Age*, Dec. 13, 1923.

PERFORMANCE OF CENTRIFUGAL AND RECIPROCATING PUMPS FOR COAL MINES

	Pump Data	
Type of Pump	Horizontal, Duplex Cast-Iron	8-in. Six-Stage Centrifugal
Material	Cement-Lined	Bronze
Number of pumps in station	2	2
Capacity of each pump, g.p.m.	1,500	1,500
Head in feet	600	600
Pump efficiency, per cent	85	75
Combined efficiency, per cent	78	69
Kw. input to driving motor	217	246
Kw.-hr. per year for half-time operation	950,000	1,078,000
	Initial Costs	
Pumps	$28,000	$9,000
Motors and control apparatus	6,000	5,000
Pump room	8,000	2,500
Foundations	500	200
Installing	1,200	300
Total initial investment	$43,700	$17,000
	Yearly Operating Costs	
Interest and depreciation, at 15 per cent	$6,560.00	$2,550.00
Repairs	2,400.00	600.00
Labor making repairs	1,400.00	200.00
Power	14,250.00	16,170.00
Operators	5,480.00	5,480.00
Total	$30,090.00	$25,000.00

Heat Applications and Material Handling

Electrical Heating Installation.—GUIDO SEMENZA.—A detailed story of a successful electrical heating installation in operation in a big building at Rome. The author deals first with the preliminary studies and calculations. Then he describes the construction and what the obtained results have shown. The building covers an area of about 30,000 sq.ft. and the installation consists of four boilers in which the water is electrically heated and then forced through 192 radiators. The following subjects are treated in detail: the amount of electrical energy required, temperature requirements, amount of heat to be stored, dimensions of the boilers, quality of water, regulation and control of the installation, etc. Important data about the performance of the installation based on one year's operation are reported and discussed.—*Elettrotecnica*, Oct. 25, 1923.

Manufacture of Ferro-Vanadium by Electric Furnace.—E. K. SCOTT.—An electric furnace developed especially for the manufacture of ferro-vanadium is described. The input is 4,000 kw., three-phase, at 220 volts and 60 cycles. It is built of cast-iron segments bolted together, measuring 16 ft. 4 in. long by 12 ft. 8 in. wide by 7 ft. 10 in. high. The total weight with roof and electrodes is about 80 tons. The automatic control equipment is also described.—*Engineer (England)*, Dec. 14, 1923.

Electrophysics, Electrochemistry and Batteries

Medical and Surgical Electrical Applications.—GIUSEPPE PANBIANCO.—A description of the various electrical applications for medical and surgical purposes is given in this article. Radiology is especially treated. A comparison is made between the Röntgen and Coolidge tubes, and the author discusses the progress made by the latter.—*Elettrotecnica*, Nov. 15, 1923.

Study of Stress-Strain Problems by Means of Röntgen Rays.—The article first gives a résumé of the progress made in Röntgen-ray researches, particularly as regards the examination of the quality of joints and welds, showing cracks and cavities in masses of steel and the disclosing of flaws in large blocks of metal. Then the researches made by Dr. Czochralski along this line are described. By means of these researches it is possible to watch the progressive changes which increasing fineness of grain and increasing amounts of stress and recrystallization produced in aluminum. — *Engineering (England)*, Dec. 14 and 21, 1923.

Pressure Effect in Gaseous Discharges. — IRVING LANGMUIR. — Two methods are described for measuring the space potential in ionized gases. The first consists of the use of a hot sounding electrode whose potential is adjusted until the electrons emitted by it are just able to escape. The second is based upon a kink observed in a semi-logarithmic plot of the current-voltage curve of a cold sounding electrode, which occurs when the electrode reaches the same potential as the surrounding space.—*Journal of Franklin Institute*, December, 1923.

Telegraphy, Telephony, Radio and Signals

Poulsen Arc Operation on Coupled Circuits.—G. PESSION.—More information on this subject is given by the author, who demonstrates that the operation of the Poulsen arc on coupled circuits is not substantially different in its results from the operation of triod tubes. A new theory based upon rational physical foundations and a series of tests that verify the theoretical conclusions is reported and fully explained. —*Elettrotecnica*, Nov. 25, 1923.

Alkali-Vapor Detector Tubes.—H. A. BROWN and C. T. KNIPP.—The authors describe unusual and very desirable results obtained on priming tungsten filament three-electrode vacuum tubes with an alloy of potassium and sodium when such tubes are used as detectors of radio-frequency currents in receiving circuits. The method of preparing the tubes and of introducing the alloy is described in detail. Curves show the static characteristics of the tube, the operation characteristics when used as detectors, also the effect of filament temperature increase upon their performance. This paper is to be presented at the midwinter convention.—*Journal of A. I. E. E.*, January, 1924.

earnings remaining after the payment of all fixed charges and stock dividends amounted to $7.77 a share on the outstanding non-par-value common stock. The Consolidated Gas Company of New York and its affiliated companies will spend a total of $69,000,000 in 1924 for additions and extensions to their producing and distributing systems, compared with an aggregate gross capital expenditure in 1923 of $50,810,332.

The Alabama Power Company's net earnings increased from $2,750,722 in 1922 to $3,585,073 in 1923, a difference of $834,351. Total gross earnings for 1923 were $7,863,293, against $5,745,321, an increase of $2,117,972 over 1922.

Inductive Co-ordination Topic of Pennsylvania Meeting

The Pennsylvania Electric Association and the Eastern Geographic Technical Section, N. E. L. A., had a very successful meeting in Philadelphia on January 16 and 17. More than three hundred were present and the committee attendance was over 75 per cent. Several good papers were discussed. R. N. Conwell told about the recent developments in inductive co-ordination, saying that the N. E. L. A. was pledged to the co-operative solution of co-ordination problems and was pushing the formation of state joint committees to act as informed and definite agencies in the anticipation of co-ordination problems and as clearing houses and to serve as advisers to local interests. The American Committee on Inductive Co-ordination has been formed and will bring under one head all light and power, telephone, telegraph, electric railway and steam railroad co-ordination work. At present each state committee will treat the telegraph and railway interests as individuals.

The principle of power-station auxiliary drives and controls formed the subject of an able paper by H. W. Smith of the Westinghouse Electric & Manufacturing Company.

A. N. Cartwright of the West Penn Power Company discussed the general education of utility employees and stressed the point that public relations start at home. W. W. Lewis of the General Electric Company gave a comprehensive paper on factors governing the selection of transmission-line voltages. H. B. Harmer of the Philadelphia Electric Company talked on safety. The effect of voltage fluctuations on lighting was treated in an illustrated and informative paper by C. A. Williams of the Philadelphia Electric Company.

At the luncheon on Wednesday greetings from President Johnson of the N. E. L. A. were presented by C. J. Russell, and at Friday's luncheon Chairman H. P. Liversidge of the National Technical Section gave an address in which he urged committees to concentrate on definite objectives. P. H. Chase, chairman Eastern Geographical Technical Section, and the various committee chairmen outlined plans for the ensuing year.

Union Carbide Wants Nitrate Plant No. 2

Would Take for Chemical Manufacture 50,000 Hp. Positively and as Much More Conditionally—Henry Ford Renews His Offer with Suggested Modification

DISCUSSION of the various offers for the government's Muscle Shoals properties before the military affairs committee of the House of Representatives has had the effect of bringing these offers to a comparable basis. The committee, or a special committee, if one should be appointed, now has before it information which will permit it to negotiate. The sentiment on the committee in favor of the Ford offer, however, is so strong that there is determined opposition to the appointment of a joint negotiating committee, and it is not unlikely that the committee will report favorably upon the Ford offer without taking advantage of the unusual opportunity which it has to make a better deal with the interests that have submitted offers.

The Union Carbide Company submitted its offer Wednesday. The offer is a proposal to lease Nitrate Plant No. 2, Waco Quarry and 50,000 hp. of power. The company agrees to take up an additional 50,000 hp. under certain conditions. It agrees to pay $150,000 per year for the use of the plant and the quarry. The company plans to operate the plant to produce urea and phosphazote at cost plus 5 per cent. It agrees to conduct research and promises to maintain a production capacity of 40,000 tons of nitrogen for full fifty years.

FORD SUBSIDY WOULD BE $15,000,000

Among the points made at last week's hearing before the House military affairs committee was a calculation showing that electricity produced at Muscle Shoals during 1926 would cost Mr. Ford less than 1 mill per kilowatt-hour of primary power. In 1936 it would reach its maximum cost at 1.9 mills per kilowatt-hour. This is one-sixth of the amount a similar volume of power would cost any other user. Based on the primary power alone at Muscle Shoals, this would make a difference of $15,000,000 per year. That is the amount, it was argued, to which the government would be subsidizing Mr. Ford's industry. If he should choose to use the power for the operation of cotton mills, it was pointed out, all would understand that the owners of all other cotton mills of the country would be at a great disadvantage because of Mr. Ford's governmental subsidy.

On Tuesday Representative Kahn, chairman of the committee, presented to it the following telegram which he had received from Henry Ford:

"Our offer for Muscle Shoals still stands. The MacKenzie bill, with the Madden amendment, as printed in the Madden bill, is satisfactory with following suggested amendments of Section 19, page 17, beginning at line 5 of the Madden bill: 'A suitable site for a steam-power plant, to be located at or near lock and dam No. 17, Black Warrior River, Alabama, or upon a site to be mutually agreed upon by the government and Henry Ford, together with a strip of land 100 ft. wide to serve as a right-of-way for transmission and transportation purposes between dam No. 17, Black Warrior River, or a site to be agreed upon between the government and Henry Ford, and nitrate plant No. 2, Muscle Shoals, Ala., with connection to Waco quarry near Russellville, Ala.'; remainder of section as appears in bill."

A representative of the Southern Public Utilities Company estimated the cost of the right-of-way from lock No. 17 at $100,000, if the intention is to build a railway line. If it is simply for a transmission line, the cost would be $46,000.

One of the most telling points brought out against the Ford offer was the fact that while the public utilities companies would be rigorously regulated, no such safeguard would exist were the Ford offer accepted.

Oscar G. Merrill, secretary of the Federal Power Commission, declared before the committee that acceptance of Henry Ford's offer would tend to break down the Federal power act. Mr. Merrill testified in support of the Dickinson bill, which requires that Muscle Shoals shall remain under the Federal Power Commission, no matter to whom it is sold.

For Nitrate Manufacture

Three Southern Companies Offer to Give $1,000,000 and to Set Aside 100,000 Hp.

IN SEQUEL to the offer of nine Southern power companies to take over the United States government's properties at Muscle Shoals, Ala., under a fifty-year lease, during which term interest on the government's investment would be paid in a sum approximately $100,000,000 (see ELECTRICAL WORLD for January 12, page 107), a further offer was made to Secretary of War Weeks last week signed by C. M. Clark, chairman, for the Tennessee Electric Power Company; E. W. Hill, vice-president, for the Columbus Electric & Power Company, and Thomas W. Martin, president, for the Alabama Power Company. This three-company offer, while more detailed, is in essentials a repetition of the previous nine-company one. The companies plan to create a ten-million-dollar corporation to carry out the proposed agreement and to contribute a fund of $1,000,000 to be used under direction of the government for scientific research in production of fertilizers and nitrates and in agricultural experiments, the companies agreeing also to set aside 100,000 hp. for that purpose.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Expect Record Convention

Institute's Meeting at Philadelphia Attracts National Attention—Anniversary Features

IN PHILADELPHIA during the week of February 4 the American Institute of Electrical Engineers, which will then celebrate its fortieth birthday, expects to hold the biggest midwinter convention of its history. In addition to technical papers numbering more than forty there will be many features of national interest.

On Monday evening Elmer Sperry, T. C. Martin, Elihu Thomson and J. J. Carty will speak at the anniversary celebration, and in addition Samuel Insull, President Ryan and the Edison medalist, John W. Lieb, will address the delegates and visitors. On Tuesday afternoon L. F. Fritch and L. G. Coleman, prominent railroad men, will present papers on rail transportation, and short talks will be given by eight or ten other representatives of railroads. In the evening national aspects of the transportation industry will be the subject of a series of addresses in the Metropolitan Opera House, which will be broadcasted from many stations.

On Wednesday afternoon the Institute men will visit the Moore School of Electrical Engineering at the University of Pennsylvania, where Dean Harold Pender, with the co-operation of several manufacturers, has arranged for an exhibit of the latest research laboratory developments. On Friday the Bethlehem Steel Works and Lehigh University will be visited.

On Thursday night the annual dinner dance will be held, and on Wednesday night an illustrated lecture by Frank G. Baum will be followed by an informal entertainment and dance. Visiting ladies are to be entertained by the local ladies' entertainment committee, and advance registrations indicate an unusually large attendance of members and their families. Chairman W. C. L. Eglin of the local convention committee anticipates a record convention.

Federal Government Asks Dismissal of New Jersey Suit

The Department of Justice filed in the Supreme Court last Saturday a motion to dismiss the original proceedings brought by the State of New Jersey to have the Federal Power Commission and the Attorney-General restrained from enforcing the federal water-power act.

The brief contends that the case presented by New Jersey does not show any actual conflict or controversy between state and federal authority which presents an issue for the consideration of the Supreme Court; also, that the failure of the state to enroll the United States as a party to the suit is a fatal defect. The Attorney-General further contends that the bill filed by New Jersey does not present any concrete complaint and that its objections are based on things it is "contemplating" or "intends" to do.

Join Issue in Tennessee Case Against Electric "Trust"

The case brought against the Tennessee Electric Power Company and its affiliated companies by the State of Tennessee, which charges them with violation of the anti-trust laws of the state, came up last week in the Chancery Court at Nashville before Chancellor Newman. The Attorney-General declared that the merger comes clearly within the provisions of an anti-trust act passed in 1903. Public policy in the state, he said, has decreed that electricity is an article of commerce and that any combination of companies manufacturing electricity which tends to eliminate competition and to fix prices is clearly in violation of the statute. There can be no question of whether or not electricity is a manufactured article, the franchises of the companies represented in the consolidation showing they were organized "for the purpose of manufacturing electricity."

He declared that the state is not insisting that power companies have not the right to consolidate under some conditions; that the state is not insisting that the utilities commission has not the authority to fix rates and control competition within certain bounds, but, he said, the state is insisting that the merger of Tennessee power companies, as is shown by the various steps leading to the combination, clearly indicates a purpose to control prices and to stifle competition. He insisted that at each step competition was stifled and that the various contracts entered into were for the purpose of securing bigger profits.

Counsel for the companies attacked the validity of the 1903 statute as applied to electric power companies under commission regulation, insisting that not only has there been no stifling of competition, but that no competition between the different companies represented in the consolidation was or is possible.

Decision was reserved.

Financial Gains in 1923

Electric Light and Power Companies in All Parts of the Country Forge Ahead

REPORTS now being published of the earnings of prominent electric light and power operating companies in 1923 show large gains in all parts of the country, many records having been broken. A few figures from the reports of some of the larger companies may be taken as widely characteristic.

The earnings of the Commonwealth Edison Company of Chicago were the largest in its history and will exceed dividend requirements of $5,760,000 by $2,000,000 or $3,000,000. In 1922 the previous record year, $6,276,375 was earned on the $60,000,000 capital stock then outstanding.

The Detroit Edison Company has also completed its best year. Gross earnings of $31,724,000 compare with $26,352,000 the year previous, an increase of $5,372,000. The balance after charges, including depreciation, is $5,147,000, which is equivalent to $11.86 a share on the approximate 435,000 shares of capital stock now outstanding and compares with $3,259,000 in 1922, or $10.48 a share on the then 344,000 shares outstanding.

The Pacific Gas & Electric Company's 1923 showing is one of the best ever reported. The balance after preferred dividends and depreciation will total about $3,650,000, equivalent to $10.24 a share on the 356,300 shares of $100 par common now outstanding and comparing with $4,013,000 in 1922, or $12.87 a share on the then 346,800 outstanding shares. This showing has been made in the face of rate reductions which have reduced gross earnings approximately $3,500,000. Based on 1922 rates, the company's earnings would have substantially bettered all previous years.

The New York Edison Company, the United Electric Light & Power Company, the New York & Queens Electric Light & Power Company, the Bronx Gas & Electric Company, the Westchester Lighting Company and the gas and smaller properties which are affiliated with the Consolidated Gas Company of New York had combined gross earnings for 1923 of $123,741,998, against $113,086,372 for 1922, an increase of $10,655,626. Net earnings were $35,808,770, compared with $31,827,629 in 1922, a gain of $3,981,141. Total dividends paid in 1923 were $15,439,750, against $8,562,600 in 1922, an increase of $6,877,150. Although the net earnings amounted to but 6.47 per cent on the total investment, the surplus

Changes in Power-Plant Practices

Discussions Before Chicago Meeting of the A. S. M. E. on Boiler Furnaces, Chain Grates, Underfeed, Powdered Fuel and Heat Absorption

SEVEN papers on subjects of interest to companies generating power from steam were presented at the one-day convention of the American Society of Mechanical Engineers in Chicago, January 15. Many changes in power-plant design and operation which have been brought about by changed operating conditions were discussed.

P. W. Thompson, chief assistant engineer of power plants, Detroit Edison Company, said, in a paper on "The Central-Station Power Plant," that distinct approaches to greater efficiency are being made in the boiler room and the turbine room. In the boiler room four plans of procedure are being followed. In old plants, or at least in those where the use factor is high, economizers are being installed which permit 5 to 7 per cent increase in boiler efficiency, thereby justifying the increased investment. Air pre-heaters are also being installed in such plants and are increasing the boiler efficiency about the same amount, although it is a question how far companies should go in this direction. Powdered-fuel burning is gaining impetus. There has also been considerable development in underfeed and chain-grate stokers with special furnace settings and ventilation (air, steam and water), reducing refractory maintenance materially. In the turbine room two plans of procedure are being followed—higher pressures and higher temperatures.

In the discussion which ensued George C. Daniels, Peoria, Ill., doubted whether most engineers know where they are going. At present 400-lb. steam pressure is being tried in Peoria, and a house generator and exciter are mounted on the main turbine shaft in addition to the main generator exciter. An economy of 1 kw.-hr. per 16,000 B.t.u. with a load factor of 40 per cent is expected.

Alex D. Bailey, Commonwealth Edison Company, declared that operators are chiefly interested in continuity and reliability of service. That plants can be run continuously at 14,000 to 16,000 B.t.u. per kilowatt-hour is interesting, but the effect of interruptions of service on public opinion must be remembered.

John Anderson, chief engineer Milwaukee Electric Railway & Light Company, favored a bold policy of advance. His company is trying radiant superheaters, which have been installed in boiler furnaces for six months to reduce the cost of brick maintenance. During this period, and operating at 250 per cent rating with 15 to 16 per cent CO_2, no visible deterioration of the brickwork has been noticed.

Paper on Pulverized Fuel

The design of the furnaces was held by Henry Kreislinger, Combustion Engineering Company, who presented a paper on pulverized fuel, to be the most important factor in boilers burning powdered coal or fuel in any other form.

Five other excellent papers were presented at this meeting. G. R. McDermott, assistant chief engineer Illinois Steel Company, dealt with power generation in a modern steel plant; Joe Worker, American Engineering Company, and J. Van Brunt, chief engineer Combustion Engineering Corporation, discussed respectively underfeed and chain-grate stokers; burning waste coal in pulverized form was the topic of Ralph Galt, Fuller Engineering Company, and conditions affecting heat absorption were described by Loyd R. Stowe, manager stoker department, Laclede-Christy Clay Products Company, St. Louis.

Hartford Company Loses Intercompany Contract Case

The petition of the Hartford Electric Light Company for an order by the Connecticut Public Utilities Commission to set aside alleged discriminatory prices in a contract executed by it and the Union Electric Light & Power Company and to substitute non-discriminatory prices therefor, as outlined in the ELECTRICAL WORLD for December 15, page 1234, has been denied. The contract between the two companies was executed in 1913, and when the necessity for upward revisions in rates arose during the war period the Union company declined to modify the agreement to that end, contending that to obtain industrial power business it had made substantial investments in line, substation and distributing equipment that would be jeopardized by a rate increase and that the contract should be allowed to run its course. The Hartford company contended before the board that the rates to the Union company constituted a discrimination against its other customers, and citations were offered to demonstrate the commission's authority to modify the contract.

The commission holds that a utility is under no duty to render all customers exactly the same kind of service and at a uniform rate. The commission does not find discrimination among customers of the same class, there being little similarity between the service furnished the Union company and that furnished other customers. The difference in rates between the Union company and other customers of the Hartford company, the board finds, may be due to differences in conditions of service.

The petition might have been denied on the ground alone that discrimination has not been proved, but the board goes further and holds that the word "discriminatory" must be construed with its context rather than separately so as to permit the exercise of the state police power through the commission in those cases only where the facts show that the discrimination in the contract rates affects public welfare.

Daugherty's Views on Trade Association Statistics

Publicity has recently been given to letters designated as "informal" which passed between Secretary of Commerce Hoover and Attorney-General Daugherty subsequently to the decision by which the Supreme Court in the Tile Manufacturers' Credit Association case imposed drastic limitations on the co-operative gathering of trade statistics covering production, shipments, stocks and prices. (See ELECTRICAL WORLD for December 8, page 1195.) Secretary Hoover voiced the fear that associations now submitting valuable statistics to the Department of Commerce would discontinue their collection.

The most significant paragraphs in the Attorney-General's reply are perhaps those in which he takes issue both with the assumption that there can be nothing contrary to the anti-trust act in the imparting of information relating to past and closed transactions and with the further idea that no exchange of information between association members can be unlawful if at the same time publicity be given thereto through the press or some governmental agency. "The illegality as well as the evil results," according to Mr. Daugherty, "arise from the co-operation among the members pursuant to a positive or tacit understanding and this co-operation is not affected by publicity. Those who purchase the commodity, though fully informed as to the activities of the association, can protect themselves only by an organization and co-operation of like character, which, if it were lawful, is an impossibility."

New Board for American Engineering Council

Col. J. H. Finney of Washington, Prof. Dugald C. Jackson of the Massachusetts Institute of Technology, C. E. Skinner of Pittsburgh and F. B. Jewett and L. F. Morehouse of New York have been chosen to represent the American Institute of Electrical Engineers on the executive board of the American Engineering Council for the coming year. Dean M. E. Cooley, Fred R. Low and others will represent the American Society of Mechanical Engineers. M. G. Lloyd will represent the American Society of Safety Engineers, S. H. McCrory the American Society of Agricultural Engineers, and H. E. Howe the American Institute of Chemical Engineers. For purposes of organization the country has been divided into eight districts, each of which will have a representative on the executive board.

The Alabama Power Company, which is the owner of the site of the proposed Dam No. 3, agrees to donate this property to the United States, if the government decides to build the dam, and to install at its own expense all generating units when required to meet market demands for power.

NITRATE MANUFACTURE

The main clauses covering the manufacture of nitrates for fertilizing or defensive purposes, which are evidently designed to meet the emphasis laid on that aspect of the situation by the supporters of Henry Ford, read in substance:

"Upon the completion of No. 2 project, the power company will furnish and deliver for fifty years at any point within 5 miles of Dam No. 2, at such voltage as may be desired and at actual cost to the power company, up to 60,000 hp. to be used solely in the manufacture of fertilizers. Upon the completion of No. 3 project, the power company will furnish and deliver for fifty years at any point within 5 miles of Dam No. 3, at such voltage as may be desired and at actual cost to power company, 40,000 additional horsepower for use solely in fertilizer manufacture. To the extent that the fertilizer company does not use power for such purpose, the power may be used by the power companies in public utility service.

"The power company also agrees to create a fund of $1,000,000 which shall be used in electrochemical research in the interest of agriculture and the national defense. The expenditure and administration of such fund, both principal and interest, shall be under the control of five directors, one of whom may be from time to time designated and removed by the Secretary of Agriculture, one by the Secretary of War, one by the Secretary of Commerce, one by any corporation engaged in the manufacture of fertilizers at Muscle Shoals under contract with the government, and all not so designated may be from time to time designated and removed by the power company."

The bid of an unnamed fertilizer company which proposes to manufacture the product in connection with the Southern utilities was expected to come before the House committee on military affairs on Friday.

Aylesworth Talks to Fixture Manufacturers

A cross-section picture of the central-station industry was painted by M. H. Aylesworth, managing director of the N. E. L. A., on Wednesday at the eighth annual convention of the National Association of Lighting Equipment Manufacturers and Dealers, which was held during the entire week at the Hotel Sherman, Chicago. He dwelt on public relations and customer ownership, pleading for an appeal to the public through their human emotions and not, as formerly, through the presentation of cold engineering facts.

"Working with the Architect" was the object of a round-table discussion directed by W. L. Collins, Pittsburgh. This relationship was considered very important in order to obtain the sought-for 3 per cent of the building cost for fixtures. It was brought out that some fixture dealers were obtaining 30 per cent of their business from the architects.

Officers elected are: President, E. R. Gillet, Toledo; vice-president, H. I. Sackett, Buffalo; treasurer, R. D. Paxson, Cleveland. J. C. English of Portland, Ore., C. J. Netting of Detroit, A. L. Oppenheimer of Cleveland and W. Forvey of Los Angeles were added to the directorate.

Contractors Favor Selling

Wisconsin Society Debates Merchandising and Discusses Rural Lines at Milwaukee

A DEBATE as to whether the contractor-dealer is the proper person to merchandise electrical equipment was the main event of the seventh annual two-day convention of the Wisconsin State Association of Electrical Contractors and Dealers, held at Milwaukee on January 17 and 18. It was won by E. D. Herzeberg, Milwaukee, who upheld the affirmative. His main reasons were that contractor-dealers were in the field for a market development, they could advise as to the use of the equipment, and they could furnish the necessary servicing. P. C. Burrill, Milwaukee, upheld the negative by quoting bankruptcy figures among contractor-dealers, saying that these men knew very little about merchandising principles. The judges declared that while the large question must be answered affirmatively, each case should be judged on its individual merits because of the merchandising characteristics needed to make a successful contractor-dealer.

Merchandising fundamentals were dealt with by H. P. Sanburn, Chicago, when he outlined as the three basic principles a fruitful field of endeavor, an aggressive sales policy and a proper place of business.

G. C. Neff, vice-president Wisconsin Power, Light & Heat Company, Madison, spoke on rural lines. Before next June, Mr. Neff declared, there will be ten experimental electrified farms similar to that now operating at Red Wing, Minn.

Laurence W. Davis, outlined the functions of the Association of Electragists International and explained how it could be made to work for the development of the contractor-dealer. He indorsed the plan for a uniform estimating system which would be flexible enough to be profitable to contractor-dealers all over the country and pleaded for the fostering of a more active industrial conscience among them.

These officers for the ensuing year were chosen: Chairman, L. W. Burch, Madison; treasurer, J. L. Acker, Sheboygan; secretary, H. M. Northrup, Milwaukee. Total registration was 165.

Municipal Plans of the Two Big California Cities

An ordinance passed several weeks ago by the Board of Supervisors of San Francisco delaying action eight weeks on the valuation of the two private distribution systems in that city was rescinded and legislation paving the way to a bond election for acquiring a municipal distribution system was passed at a meeting of the board on January 21. A resolution calling on the California Railroad Commission to fix a valuation for condemnation purposes on the city distribution systems of the Pacific Gas & Electric Company and the Great Western Power Company was passed at the same time. The amount of the bond issue for a distribution system is tentatively set at $15,000,000. At the same time that this question is put to a vote of the people another bond issue of $24,000,000 to complete the water end of the Hetch Hetchy project will be submitted. The date of the election will be set within three weeks.

Referendum petitions bearing fifty-eight thousand signatures have been filed with the City Clerk of Los Angeles by the Los Angeles Gas & Electric Company which will compel the City Council to place before the voters or else repeal the two ordinances authorizing the expenditure of $50,000 to have the Railroad Commission make a valuation of the properties of the private corporation as a basis for condemnation proceedings by the city to acquire the electrical properties of the company and make them a part of the municipal distribution system.

Minnesota Power & Light to Spend $20,000,000

Announcement is made of the purchase by the Minnesota Power & Light Company, whose progress was described in the ELECTRICAL WORLD for December 15, page 1238, of the Little Falls (Minn.) Water Power Company, as well as of the Blanchard Rapids power site on the Mississippi River, 8 miles south of Little Falls, which was owned by the Pike Rapids Power Company, a subsidiary of the Little Falls company. Work will, it is announced, begin at once on an 18,000-hp. hydro-electric plant at Blanchard Rapids, with an ultimate capacity of 27,000 hp., and on a high-tension line to connect the existing Duluth-Mesaba Range system with Little Falls and Blanchard Rapids. A budget of $7,000,000 is being allowed for work on these projects in 1924, increasing the company's development plans for northern Minnesota, including Duluth, to a point involving $20,000,000.

Following the action of the Minnesota Power & Light Company in securing control of the Pike Rapids project, modifications are being made in the plans. Instead of three 8,000-hp. units, it now is planned to install five smaller units. The aggregate power developed will be the same.

New York Commission's Views on Electrical Problems

In the annual report of the New York Public Service Commission, just presented to the New York Legislature, the views of the commission on a number of topics closely connected with the operation of electric light and power companies are expressed. Among these is the use of sub-meters installed in apartment houses by their owners, over which the commission has no jurisdiction under the present law. It says this problem is becoming serious and some measures should be taken "which will relieve the public from the burden which it is undoubtedly sustaining through inaccurate sub-meters." "Sub-metering need not be an evil," the commission adds. "Proper supervision and control will fairly meet the demands of the situation. If proprietors of apartment houses are to be permitted to sell energy to their tenants, some means of systematic testing must necessarily be devised."

Regarding the demand for electrical service in rural sections the report says: "Problems presented by this demand threaten to become overwhelming. Many corporations appear to have lost sight of a very fundamental fact in connection with this problem. Rural development is bound to come and must eventually reach into the extreme sections. . . . However, such a distribution entails a heavy loss through the component parts of the system which in many cases are required to serve individuals on the farm, while in the more settled sections such component parts may serve a much larger number. The dividing line is here presented between serving the farmer at a rate which will not result in positive loss and a rate which will provide a reasonable profit. It is essential therefore that some means be devised whereby the rates charged in the rural sections will not be such that those applicable in the urban sections must bear the loss resulting from rural service."

After referring to favorable results from an intensive study of rate schedules, made by the commission, the report deals with meter testing and the complaints that arise because customers underestimate the energy consumed by appliances. The commission urges that the companies should give detailed information along this line. The report speaks of the growing use of the electric range with the consequent demand for a special cooking or heating rate and indorses the "active-room" rate now in force in some communities.

New York Senator Wants to Make Commission Elective

State Senator Fearon has introduced a bill at Albany amending the Public Service Commission law of New York State by increasing the number of public service commissioners from five to nine, one to be elected from each judicial district in 1924 for a term of years corresponding to the number of the district in which he is elected, the term thereafter to be for the period of nine years.

George Otis Smith on Maine's Water-Power Policy

Dr. George Otis Smith of the Geological Survey, who is a native of Maine, is writing a series of short open letters on the water-power policy of that state. These letters, of which the first four have been issued, dated January 15, 17, 19 and 22 respectively, are addressed to Chairman Charles E. Gurney of the Maine Public Utilities Commission and are written in advocacy of the abandonment of the present policy of the state in prohibiting the exportation of hydro-electric energy and of Maine's joining with the other states on the North Atlantic seaboard in promoting interstate transmission.

In his first letter, called "What Shall We Do with Our Water Powers?" Dr. Smith denies that advocates of superpower are casting "covetous eyes" on the water power of Maine and shows how Maine's policy is injuring, not the other states, but herself. In his second letter, "What Superpower Means," he describes the growth of the Skowhegan Falls plant through the transmission of its energy to other towns and counties and draws an analogy between intercounty and interstate transmission. In his third letter, "Is Maine's Water-Power Policy Honest?" Dr. Smith says Maine's policy is out of harmony with American principles and lacks equity if not common morality. In his fourth letter, "The Profit in Partnership," he asserts that if Maine waits too long she may be deprived of the New England market for hydro-electricity by importation of Canadian power. Other letters in the series will follow in rapid succession.

Another Course on Industrial Electric Heating

The industrial heating committee, Power Bureau, Commercial National Section of the National Electric Light Association, has arranged for two courses in industrial electric heating beginning March 17 and concluding on March 29. One course will be given by the Westinghouse Electric & Manufacturing Company at its Mansfield (Ohio) works, and the other by the General Electric Company at Schenectady, N. Y. Tuition is free, the only expense involved being for traveling and hotel and amounting to approximately $200.

Those taking the Westinghouse course will report to Wirt S. Scott, Mansfield works. Those taking the General Electric course will report to Harold Fulwider, Schenectady works. Enrollments are in charge of Wirt S. Scott, chairman, who is manager of the industrial heating section of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Electric Utility Consolidation in New Hampshire

More reliable service at less cost warrants the acquisition by the New Hampshire Power Company of the Newport, Sunapee, Contoocook and Antrim-Bennington Electric Light companies, the Canaan-Enfield Electric Company and the Hillsboro Electric Light & Power Company, according to a decision of the New Hampshire Public Service Commission issued Jan. 10. All of these selling companies except the Hillsboro are jointly controlled by the Central Light & Power Company of Massachusetts, but have been operated separately. They will be consolidated and operated as a unit with an interchange of power, much of it hydro-electric.

A second petition by the New Hampshire Power Company asks permission to purchase the Lake Sunapee Power Company, which is a public utility selling hydro-electric energy to the Newport and Sunapee companies. This is for the public good, the commission finds, and permission is accorded.

Alabama Power Aids Farm Electrification Research

In accordance with previous announcement, definite arrangements have been completed between the Alabama Power Company and the Alabama Polytechnic Institute at Auburn whereby research work of a more comprehensive nature than has before been attempted in that state will be conducted to find practical means and methods of supplying Southern farmers with electric power, and detailed plans have been made public by Spright Dowell, president of the school, and Thomas W. Martin, president of the company. Sufficient funds have been appropriated by the Alabama Power Company to cover the cost of experiments over a three-year period, during which research work in electrifying agriculture will be made on farms in different sections of Alabama. An agreement has been signed, and actual work will begin at once.

The Alabama Power Company will furnish electrical engineers who will work in co-operation with agricultural engineers of the experiment station at Auburn. They will determine how electric power may be delivered to the farms of Alabama and utilized in farm homes and in farming operations. Under the agreement the company will build experimental lines in agricultural districts of different types where the application of electricity to agriculture is believed to be most feasible.

In conjunction with the work in rural sections the experiment station will be completely electrified, and the several departments will make a careful study of the possible uses of electricity in all agricultural activities. The work at the experiment station as well as that throughout the state will be under the immediate direction of the department of agricultural engineering.

Briefer News

Officers of Electric Club of Louisville.—Leon W. McLellen, commercial manager of the Kentucky Utilities Company, was recently elected president of the Electric Club of Louisville, F. A. Hamel vice-president and David Schneider secretary-treasurer.

Electric Club of Chicago Has New Officers.—Paul W. Koch was installed as president, Edward E. Williams as first vice-president, S. R. Todd as second vice-president, John F. Burton as secretary and W. P. Bear as treasurer of the Electric Club of Chicago on January 15.

Great Lakes Division, N. E. L. A.—An open meeting under the auspices of the meter committee of the Great Lakes Geographic Division, N. E. L. A., will be held at Fort Wayne, Ind., on February 15. Papers of much interest to metermen will be presented, and there will be an inspection trip through the General Electric Company's factory.

Eldorado Plant Starts Operation.—The Eldorado (Cal.) hydro-electric plant of the Western States Gas & Electric Company, on the American River, was placed in operation on January 16. The plant contains two horizontal units of 10,000 kw. each. The opening of the plant was delayed two weeks by the bursting of the penstock when it was filled for the first time, as reported in the ELECTRICAL WORLD for January 12.

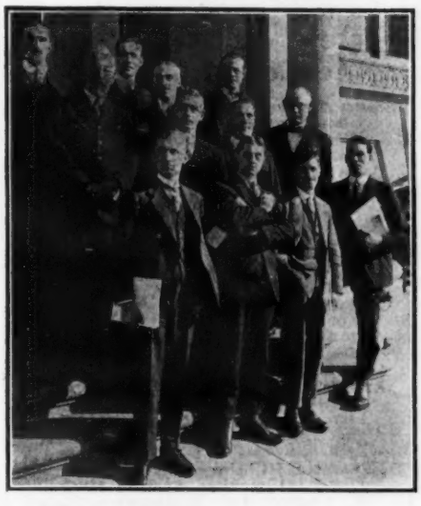
Hydro-Electric Project for Licking River.—The Federal Power Commission has received an application for a preliminary permit from the Kentucky Northern Power Company of Frankfort. The project is backed by Indianapolis capitalists led by H. A. Mansfield of the Mansfield Engineering Corporation. The site covered by the application is on the Licking River, 3 miles above Falmouth, Ky. It is proposed to erect a dam 94 ft. high, which is expected to develop 35,000 hp. The principal market for the power will be in Cincinnati and vicinity.

New Hydro Plants in Indiana.—Plans are under way, it has been announced by John A. Shafer, Indianapolis architect and engineer, for the construction of a half-million-dollar concrete dam about 50 ft. high for a hydro-electric plant on the Flat Rock River at St. Paul, Ind., 12 miles from Shelbyville. Engineers are now taking measurements, and work will start in the spring, Mr. Shafer said. At the point where it is planned to build the dam the river is about 50 ft. deep. and 225 ft. across. Another but quite unconnected plant is being built on the Flat Rock River south of Shelbyville by C. C. Shipp of Indianapolis.

Public Ownership League Appoints Committee to Push Bill.—At a meeting of the executive committee of the Public Ownership League of America, held at the Hamilton Hotel, Washington, on January 17 in connection with the gathering of the league reported last week, the following committee was appointed to work for the passage of the league's superpower bill through Congress with possible modifications on reclamation: Dr. John A. Ryan, chairman, Catholic University of America; James P. Noonan, International President of Electrical Workers; Charles Edward Russell, Benjamin C. Marsh, ex-secretary Farmers' National Council; Jennie Buell, Michigan State Grange, and Charles K. Mohler, Chicago, consulting engineer.

Plymouth, Wis., Turns and Menasha May Turn to Central-Station Energy.—A contract has been entered into between the City Council of Plymouth, Wis., and the Eastern Wisconsin Electric Company, Sheboygan, to furnish electrical energy to Plymouth for ten years from January 1. The municipal plant will not be dismantled, but will be utilized in the event of trouble developing along the transmission line between Plymouth and Sheboygan. Menasha, in the same state, has been recommended by the Wisconsin Railroad Commission to buy its power from the Wisconsin Traction, Light, Heat & Power Company rather than add additional equipment to its municipal plant, the present plant as now equipped to be retained for use in emergency.

European Lamp Specialists Here to Study Lighting



PHOTOGRAPHED here are representatives of foreign incandescent electric lamp manufacturers now touring the United States for the purpose of studying American lighting practice and methods. They will spend two months in this country and will visit Niagara Falls, Cleveland, Chicago, Detroit, Newark, Schenectady, New York, Boston and Washington. In the group are seven from Great Britain and one from Germany. Others from France, Spain and Italy had to abandon the trip at the last moment.

Oklahoma-Texas High-Tension Line.—The Southwestern Light & Power Company of Lawton, Okla., is pushing its high-tension line to connect that city with Quanah, Tex., and expects to complete it by March 1. The line is being constructed via Snyder, Manitou, Tipton, Olustee and Eldorado. Materials are on the ground, poles and crossarms are in position, and rapid progress is being made in stringing the aluminum cable. This line is being constructed with 45-ft. and 50-ft. creosoted yellow-pine poles. The project includes extensive improvements in the company's plant at Lawton, where a 3,000-kw. Westinghouse steam turbine is being installed.

Low Water in the Middle West.—The Moline (Ill.) Water Power Company was completely shut down for a week in December because of lack of water to operate the plant, and it may again be closed until spring if assistance is not given on the Illinois side of the Mississippi River, according to A. A. Ablfinger, superintendent of the company. This company furnishes a large part of the electric power for the People's Power Company, turning out about 50,000 kw. a day, and heavy loss is threatened. Low water has also closed the Rock Island Arsenal plant, causing a few of the arsenal shops to close down until the power plant shall be able to resume operations. At Dubuque, Iowa, the plant was closed for more than an hour because of water supply failure, the longest "out" in seventeen years.

Denver's New Substation.—Equipment has recently been ordered by the Denver division of the Public Service Company of Colorado for a new substation in the main residential district which when completed will connect the entire generating and transmission system within the city as planned by the company's engineering department in connection with the future requirements for distribution when energy is supplied by the new Valmont plant, north of Denver. The substation will be built on Harrison Street.

Alabama Power Activities.—The Alabama Power Company has withdrawn its petition to the Public Service Commission for permission to erect a hydro-electric plant between Locks 2 and 3 on the Coosa River. This company continues, however, to oppose the petition of the People's Hydro-Electric Power Company to erect a plant at the same place. The Alabama Power Company has applied to the commission for leave to construct a 44,000-volt transmission line from Decatur to a point near Sheffield, where it would connect with the present line from the

Gorgas steam plant to Muscle Shoals. The line, if built, will complete a power loop in Alabama similar to that which the company previously sought when it asked permission to build a 110,000-volt line from Huntsville to Muscle Shoals. That application, it will be remembered, was denied.

Cheyenne Central Station Expanding.—The Cheyenne (Wyo.) Light, Fuel & Power Company has just replaced a 400-hp. hand-fired boiler with a 600-hp. boiler with automatic stoker. It is expected to place in service about March 1 a turbo-generator which will have a rating of 1,800 kw. and will replace two old-style engine-driven generators of a combined capacity of about 600 kw. This generator will increase the plant rating to more than 4,500 kw.

Montreal's Harbor Railway Electrification.—Work on the electrification of the railway system of the Montreal Harbor Commission is progressing rapidly toward completion. When finished the railway will serve a waterfront nearly 10 miles in length by engines which will save a great sum in fuel consumption. For shunting operations and all-round utility the new type of electric engine, of which there are two, has already proved its superiority. Shipping men are confident that the records which have been made at this port in quick loading and dispatch of vessels will be broken when the electrical system begins operation.

Interior Department Engineers Favor Flathead Lake Development.—Flathead Lake in northwestern Montana is well situated for storage of water for power development or for irrigation, according to a report of government engineers just made public by the Department of the Interior. Application for power rights on this lake was made to the Federal Power Commission months ago, but action is still delayed waiting for the Columbia River basin development projects to take shape. Smaller lakes above Flathead Lake were examined by the Interior Department engineers to determine whether storage was feasible in them. Of these it was decided that Whitefish Lake was the only one that could be used to store water for irrigation and power purposes, the others being already appropriated or the property damage being prohibitive.

N. E. L. A. to Publish Electric Transportation Textbook. — The Electric Transportation Bureau, N. E. L. A., at a meeting of its executive committee on January 16 decided to compile the lectures developed in conducting the electric truck schools which were held last year in Boston, New York, Chicago and San Francisco into a textbook on electric truck transportation. Several universities with courses on transportation have expressed a desire for such a book, and a demand is anticipated from central stations and vehicle manufacturers. The fact that the growth of hydro-electric power in other lands has brought increasing interest in electric trucks in certain parts of Europe was discussed, the sale of storage batteries for vehicle service there having increased last year more than 300 per cent. A resolution was passed for the appointment of a foreign trade committee to work with the Bureau of Foreign and Domestic Commerce in Washington in the promotion of the export market.

Colorado River Development. — A committee composed of five engineers, four of whom are in the service of the government and the fifth an outside engineer, is being organized by Secretary of the Interior Work for the purpose of advising on a definite plan for the control of floods on the Colorado River, the development of its water power and the storage of water for irrigation of arid lands in its lower basin. The personnel of the committee will include a representative of the War Department, a representative of the Reclamation Bureau, a representative of the Geological Survey, a representative of the Federal Power Commission, and another engineer, provided he can be found, not connected with the government. Secretary Work has appointed F. E. Weymouth, chief engineer of the Reclamation Bureau, to serve on the committee as a representative of that bureau. Colonel William Kelly will represent the Federal Power Commission.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

Technical National Section, N. E. L. A.—Birmingham, Jan. 28-Feb. 1.

Western Association of Electrical Inspectors—Hotel Fontenelle, Omaha, Jan. 29-31. W. S. Boyd, 175 West Jackson Blvd., Chicago.

Iowa Engineering Society—Montrose Hotel, Cedar Rapids, Jan. 29-Feb. 1. R. H. Freese, Cedar Rapids.

American Institute of Electrical Engineers—Midwinter convention, Bellevue-Stratford Hotel, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

Society for Electrical Development—522 Fifth Ave., New York, Feb. 5. J. Smieton, Jr.

Commercial National Section, N. E. L. A.—Hotel Cleveland, Cleveland, Feb. 6-7.

New Mexico Public Utilities Association—Franciscan Hotel, Albuquerque, Feb. 18-20. C. E. Twogood, Albuquerque, N. M.

American Physical Society—New York, Feb. 23.

Oklahoma Utilities Association—Huckins Hotel, Oklahoma City, March 11-13. E. F. McKay, First National Bank Bldg., Oklahoma City.

Association of Electragists, Eastern Division—Hotel Astor, New York, March 18.

Illinois State Electric Association—Hotel Sherman, Springfield, Ill., March 26-27. R. V. Prather, Springfield, Ill.

American Institute of Electrical Engineers—Spring convention, Birmingham, Ala., April 7-11. W. E. Mitchell, Alabama Power Co., Birmingham.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, April 17-18. John N. Cadby, 445 Washington Bldg., Madison.

Southwestern Division, N. E. L. A.—New Orleans, April 22-25. S. J. Ballinger, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 22-25. E. N. Willis, Dallas, Tex.

American Electrochemical Society—Hotel Bellevue-Stratford, Philadelphia, April 24-26. C. G. Fink, Columbia University, New York.

Nebraska Section, N. E. L. A.—Omaha, May 8-9. H. M. Davis, Bankers' Life Bldg., Lincoln.

National Electric Light Association—Atlantic City, N. J., May 19-23. M. H. Aylesworth, 29 West 39th St., New York.

Tacoma Municipal Plant to Be Double One. — Under a modification of the original plans for the Lake Cushman power project of Tacoma, Wash., two storage dams and two power plants are ultimately to be erected instead of one, and the tunnel from Lake Cushman to Hood Canal will be eliminated. By the new plan one power house is to be built just below the dam in the North Fork of the Skokomish River, operating under a maximum head of approximately 275 ft. The water from this plant will be discharged directly into the stream bed. The second dam will be built in a very narrow portion of the canyon of the North Fork of the Skokomish and will provide a head of 450 ft. to a power house to be built at Potlatch on the Hood Canal. The first or Cushman plant is to contain two units and develop 50,000 hp. Cost is put at $5,250,000. The second or Potlatch plant is designed for two 45,000-hp. units and will cost about the same.

Puget Sound Power & Light Has Another Big Development in View.—Stone & Webster, through the Puget Sound Power & Light Company, Seattle, have filed application with the Washington State authorities for permission to divert 4,000 cu.ft. of water from the Baker River, a tributary of the Skagit. The application foreshadows a development of 65,000 hp. and the erection of a dam 235 ft. high and 325 ft. long. Preliminary work will be undertaken this year, company officials state. Ultimately the project will cost several million dollars.

Twelve Reciprocating Engines to Be Displaced by Electric Motors in Worcester Wire Mills.—Under a contract recently signed by the American Steel & Wire Company at Worcester, Mass., with the New England Power Company, briefly referred to in a former issue of the ELECTRICAL WORLD, the north and central works of the manufacturer will be completely motorized, and with the exception of the rod and rolling mills the south works will also be electrified throughout. This electrification will displace twelve reciprocating engines. At present the New England company is supplying about 1,600 hp. to the Steel & Wire company at the north works and 4,300 hp. at the south and central works. The new contract is of ten years' duration and provides for the supply of 8,200 additional horsepower at the north works and 3,200 additional horsepower at the south works, or a total of 17,300 hp.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Ambrose Swasey, vice-chairman of the Warner & Swasey Company, machine-tool builders of Cleveland, has been awarded the John Fritz gold medal for 1924, one of the highest honors bestowed by the engineering profession in this country. Among reasons assigned for the award was the founding of the Engineering Foundation as the joint research instrumentality of the four great national societies of electrical, civil, mining and metallurgical, and mechanical engineers, Mr. Swasey being the donor of the initial fund. The medal was established in 1902 in honor of John Fritz, pioneer in the American iron and steel industry, and is awarded annually for notable scientific or industrial achievement.

Samuel D. Heed, general manager of the Union Gas & Electric Company, Cincinnati, has been made vice-president in charge of public relations.

D. C. McClure, who has been superintendent of the electric department of the Public Service Company of Colorado, Denver, has been transferred to St. Joseph, Mo., as general superintendent of the St. Joseph Railway, Light, Heat & Power Company. Both of these properties are subsidiaries of the Cities Service Company. Mr. McClure has been associated with the Denver company continuously since 1913 with the exception of the period he spent in military service. He has been an active member of the Rocky Mountain Division of the National Electric Light Association, having served as its first and second vice-president and being at the present time its president.

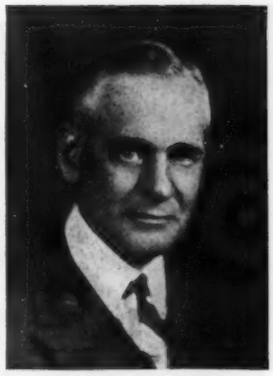
Henry Kerr, superintendent of electric production of the Public Service Company of Colorado, Denver, has been appointed superintendent of the company's electric department, succeeding D. C. McClure, recently transferred to the St. Joseph (Mo.) Railway, Light, Heat & Power Company.

Lewis C. Bennett, assistant superintendent of the Connecticut Telephone & Electric Company for the past ten years, has severed his connection with the company.

M. H. Frank, for many years in charge of the electric light and power, railway and gas properties of the Eastern Wisconsin Electric Company at Fond du Lac, Wis., has been named manager of the electric railway department of the company, succeeding B. W. Arnold, recently made manager of the motor-coach department of the Chicago, North Shore & Milwaukee Railroad. Mr. Frank will continue to have his headquarters at Fond du Lac.

W. C. L. Eglin Assumes Presidency of Franklin Institute

William C. L. Eglin, vice-president in charge of the engineering department of the Philadelphia Electric Company, was installed as president of the Franklin Institute of the State of Pennsylvania on Wednesday evening, January 16. Mr. Eglin has long been a prominent member of the Institute he has been selected to head, having served as a member of its board of managers, as its representative at the International Engineering Congress held in Paris in 1900 and during the past year as one of its vice-presidents.



W. C. L. Eglin

Mr. Eglin has been identified with the Philadelphia Electric Company and its predecessors in the electric light and power field since 1889, the year in which he came to America from Scotland, his native country. During this period he has witnessed and been a part of the vast work of consolidating into one large company the smaller companies supplying the various sections of the city. It was under his direction that the standardizing of the power-station equipment and economical distribution methods throughout the city were put into effect.

Mr. Eglin is nationally known for his contributions to the development and advancement of the industry's representative associations. In the National Electric Light Association he held successfully the offices of secretary and treasurer, second vice-president and president, and he has been a chairman and a member of many of its important committees. He is a past-vice-president of the American Institute of Electrical Engineers, a member of the Illuminating Engineering Society and of the American Electrochemical Society. As president of the Franklin Institute Mr. Eglin is succeeding Walton Clark, formerly a vice-president of the United Gas Improvement Company of Philadelphia, who is retiring as head of the institute because of ill health after twelve consecutive years of eminent service.

Fred E. Schornstein, who resigned as district manager of the Wisconsin-Minnesota Light & Power Company at Eau Claire, Wis., as was announced in the January 19 issue of the ELECTRICAL WORLD, has allied himself with the Adirondack Light & Power Corporation at Schenectady, N. Y.

Nicholas M. Du Chemin has assumed the duties of general superintendent of the West Lynn plant of the General Electric Company, succeeding the late William J. Lloyd, according to an announcement recently made by F. P. Cox, manager of that plant. Mr. Du Chemin attended the General Electric apprentice school at the River Works in Lynn and also the engineering school before entering military service in 1917. Following his naval service, he returned as a boring-mill hand to the Lynn plant of the General Electric Company, where he soon won promotion. His safety work caused his being put in charge of the Bedeaux point system in the West Lynn plant, the position he occupied when he received his recent appointment.

H. C. Blackwell, vice-president and general manager of the Kansas City Power & Light Company, was recently elected a vice-president of the Union Gas & Electric Company, Cincinnati.

Charles E. Addie has been made superintendent of the commercial lighting department of the Public Service Company of Colorado. This department has been recently reorganized.

H. N. Porter, who has been associated with the Eufaula office of the Oklahoma Gas & Electric Company, has recently been transferred to the company's power plant at Muskogee.

Nathan Clifford Grover, chief hydraulic engineer of the United States Geological Survey, Washington, D. C., has been elected the president of the Washington Society of Engineers. Professor Grover has been chief hydraulic engineer in charge of the water resources branch of the Gological Survey since 1913.

R. H. Barclay, formerly electrical engineer of the Foundation Company of New York and more recently electrical engineer for Starrett & Van Vleck, architects of New York, has entered the division of construction and engineering of Stone & Webster, Inc., in the same capacity.

J. A. Radlund, Jr., who has been associated with the Wisconsin Power, Light & Heat Company, has been placed in charge of the Wisconsin River Power Company's hydro-electric plant at Prairie du Sac, Wis. Mr. Radlund, Jr., succeeds K. F. Green, superintendent,

who was transferred to the Madison office of the Wisconsin Power, Light & Heat Company to assume larger duties. Both properties are subsidiaries of the Northwest Utilities Company.

W. J. Crock of the Southern California Edison Company has been placed in charge of the company's new Compton district, including the territory between Watts and Long Beach.

W. Goree, who has been connected with the Oklahoma Gas & Electric Company at Oklahoma City, has been transferred to Sapulpa as transmission superintendent of the central division.

Barry Wilson, who has been city electrical inspector in St. John, N. B., for the past three years, has been appointed electrical engineer for the St. John Electric Power Commission. For the past year Mr. Wilson has been electrical engineer for this commission in addition to performing the duties of city electrical inspector.

Charles E. Canada, sales engineer with the General Electric Company in the Northwest for the past thirteen years, has become associated with the W. A. Ramsay Company, Ltd., of Honolulu. This company is the Hawaiian representative for the General Electric Company, the Pelton Water Wheel Company, Charles C. Moore & Company and other manufacturers.

W. L. Webb, formerly student engineer with the General Electric Company at Schenectady, N. Y., is now associated with the Appalachian Power Company, Bluefield, W. Va., in the capacity of relay engineer.

Glenn A. Wilson, formerly associated with the Mutual Electric & Machine Company, Detroit, has been appointed manager of the New York and New England territory of the Gibb Instrument Company, Bay City, Mich., manufacturer of electric welding equipment. Mr. Wilson's headquarters are in New York.

Lieut.-Col. J. R. Langley of the Infantry Officers' Reserve Corps and principal assistant patent attorney for the Westinghouse Electric & Manufacturing Company, has been promoted to the rank of colonel. Colonel Langley, who is a graduate of the University of Michigan in electrical engineering, was associated with the United States Patent Office before entering the patent department of the Westinghouse company eleven years ago.

T. L. Phillips became manager of the investment department of the Union Gas & Electric Company, Cincinnati, on January 1. This is a newly organized department intended to handle the sales of company securities to customers and employees. Mr. Phillips has been connected with the company continuously for the last three years, devoting his chief attention to supervision of outside sales forces such as are used in extending house wiring. Nine years ago he was connected with the organization for a period of two years. He has also been identified with the General Motors Export Company and the Delco Company in their commercial activities.

C. H. Wordingham, British Consulting Engineer

Charles Henry Wordingham, British consulting engineer, has been engaged in a consulting capacity for a number of years in the transmission and distribution of electric power for projects in London, East Midlands and elsewhere and in the installation of electrical equipment for power and lighting in mills, factories and buildings. Born in Twickenham, Middlesex, in 1866, Mr. Wordingham was educated at Kings College, London, and was then articled to Dr. John Hopkinson. After a short association with the United Telephone Company he joined the engineering staff of the London Electric Supply Corporation. Following three years of service as assistant to Dr. J. Hopkinson he became city electrical engineer to the Manchester Corporation, a post he occupied for seven years. During the period which followed he acted as electrical expert, advising local authorities and private clients on electrical questions in general. From 1903 to 1918 Mr. Wordingham, as director of electrical engineering with the Admiralty, was responsible for the entire electrical equipment of the ships of the British navy and for advising on electric light and power questions in government dockyards and shore establishments.

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C. H. WORDINGHAM

Mr. Wordingham is a past-president of the Institution of Electrical Engineers and past-chairman of its Manchester Section, a member of the Institution of Civil Engineers and Institution of Mechanical Engineers, as well as of the British Engineering Standards Association, and one of the British representatives on the International Electrotechnical Commission. He has contributed many papers on engineering subjects to the institutions to which he belongs and to technical journals.

M. W. Berg, formerly connected with the Dubuque (Iowa) Electric Company, has been made local manager of the Eastern Iowa Electric Company at Dubuque, succeeding F. K. Altman, who has joined the Carr, Ryder & Adams Company of Dubuque.

W. C. Langley of W. C. Langley & Company has been elected a director of the Kansas Electric Power Company, Lawrence, Kans.

Edson R. Nigh, assistant distribution engineer in the Seattle division of the Puget Sound Power & Light Company, has been promoted to the position of distribution engineer for the North Coast Power Company, Portland, Ore. The North Coast Power Company is controlled by the Pacific Northwest Traction Company, which in turn is controlled by the Puget Sound Power & Light Company. Mr. Nigh became associated with the Puget Sound company in 1908 and has advanced through successive positions in the operating and engineering departments.

Roy Hanna has been made district manager of the Southern California Edison Company in Covina, one of the new districts which became operative on January 1. His territory includes Baldwin Park, Puente and Bassett in addition to Covina, the operating center.

R. W. Atkinson has been appointed chief engineer of the Standard Underground Cable Company, Perth Amboy, N. J.

F. K. Altman, who has been local manager of the Eastern Iowa Electric Company at Dubuque since 1915, has severed his connections with the company to associate himself with the Carr, Ryder & Adams Company of Dubuque.

J. W. McIver has been appointed to the position of advertising and publicity manager of the Edison Lamp Works of the General Electric Company at Harrison, N. J., to succeed T. J. McManis, newly made assistant to the manager of the publicity department of the entire company. Mr. McIver, who is a graduate of the University of North Carolina, class of 1913, has been employed by the Edison Lamp Works since 1916.

Obituary

George A. Speer, superintendent of the Niagara plant of the Niagara Falls Power Company, died on Friday, January 18, of pneumonia at Niagara Falls, N. Y. Mr. Speer was thirty-one years of age.

James Raymond Hammond, district manager of the division of construction and engineering, Stone & Webster, Inc., with headquarters at Cleveland, died January 7 in that city. Mr. Hammond was forty-seven years of age and had been connected with Stone & Webster since 1909. A large part of his work was performed in Texas, where he was active in electric railway construction

Commission Rulings

Reasonable Rates May Be More than Service Is Worth.—The Public Utilities Commission of Maine in hearing a complaint brought by the Phillips Village Corporation against the Phillips Electric Light & Power Company observed that it quite frequently happens that a rate which may be considered reasonable is found to be prohibitive because in the opinion of consumers it is more than the service is worth, and the failure or refusal of the public to take such service may be more serious to the utility than the selling of its product at lower rates which give something in excess of operating expenses.

Right of Eminent Domain May Be Exercised in Territory of Merged Companies.—In a case affecting the Warren Light & Power Company the Public Service Commission of Pennsylvania denied the contention of owners of property in the territory of certain companies absorbed by the Warren Light & Power Company that the acquisition of these companies did not allow the merger company to exercise its right of eminent domain in their former territory. It was held that all the territorial rights and powers possessed by the old companies passed to their successor.

What Constitutes Operation at a Loss.—In passing upon a case brought before it by the Commonwealth of Virginia ex rel. the Virginia Table Company as the purchaser of railroad property, the State Corporation Commission of Virginia said: "It is earnestly contended on behalf of petitioners that service cannot be abandoned unless the company's operating revenues are insufficient to meet its operating expenses. We do not think that this contention is sound. A railroad is not a philanthropic enterprise, and while it owes duties to the public, it also owes duties of perhaps equal importance to the investors in its securities. The holders of its securities are entitled to a return upon their investment and there is no basis in reason for requiring them to donate their capital for the conduct of a quasi-public enterprise which they might otherwise invest at a profit. To do so would be a confiscation of such capital. On the other hand, it is contended with equal earnestness on behalf of the respondents that a railroad is operated at a loss whenever it fails to earn a return on invested capital. Nor do we think this position well taken. This standard has been repeatedly rejected by this commission, by other commissions and by the courts for reasons which need not be set forth here. It is true that a public service corporation cannot and should not be required to continue service at a loss, especially when the prospect of such continuance shows only further loss. It is the opinion of this commission that a loss results when a public service corporation fails to earn its fair operating expenses, maintenance charges, depreciation, taxes and a reasonable rate of return upon a fair valuation of its property used or useful in the public service. The commission does not desire to be understood as saying that a railroad would in every case be entitled to abandon its service because of its failure to realize an income sufficient to meet all of the charges enumerated above. Such failure may be due to temporary conditions, or the prospect for increased income may be such as to render an abandonment of property unfair to the public, but certainly no loss can be said to be suffered so long as the income is sufficient to meet those charges."

Application of Minimum Charge and Separate Meters.—A complaint against the Alabama Power Company was brought before the Alabama Public Service Commission by the Selma Creamery & Ice Company, which wished the company to be forced to consolidate service rendered through two meters so that it could be measured by one instrument. Discrimination was charged, but the commission held that the complaint was not sustained by showing that a consumer operating a creamery and ice business in separate buildings over 2,000 ft. apart is required to pay a minimum charge on energy used in each building, while a competitor operating a similar business in two separate but adjoining buildings receives energy through one meter and pays but one minimum charge for the service.

Recent Court Decisions

Powers of Louisiana Commission.—Within its sphere and as to those matters of which it has jurisdiction, said the Supreme Court of Louisiana, in adjudicating a suit for mandamus brought by the Standard Oil Company of Louisiana against the Louisiana Public Service Commission, the powers of the commission are no less extensive than those of the trial courts. "Our conclusion is," the court found, "that in attempting to declare the Standard Oil Company's refinery a public utility the commission clearly exceeded its power and jurisdiction and the injunction was properly issued, but to the extent that the injunction tends to prohibit it from inquiring into matters affecting the question of whether or not the Standard Oil Company was or is operating a common-carrier pipe line, or from seeking to obtain evidence for the purpose of acting upon such matters, in controlling the operation of such business by either that company or the Standard Pipe Line Company, the writ of injunction was prematurely and improvidently issued; that application should have first been made to the commission for a modification of its orders, summonses, etc., so as to comply with the law, before applying to the courts." (97 So. 859.)*

Whether Person Electrocuted Suffered Is Question for Jury.—Damages were awarded in Nadeau vs. Inhabitants of Taunton for the "death and conscious suffering" of the plaintiff's intestate, who was killed by contact with a charged wire of the municipal lighting plant that had broken, one end lying in the gutter and the other hanging suspended from a tree. Exception was taken to the jury's having been allowed to pass upon the question of the victim's conscious suffering, concerning which the testimony from six eyewitnesses was that they heard him groan while he was falling or after he went down. The Supreme Judicial Court of Massachusetts by a majority vote held that this issue was rightly submitted to the jury. (141 N. E. 608.)

Individual Action of Wholesaler in Refusing to Buy from Manufacturer Not Restraint of Trade.—A wholesaler has the right to stop dealing with a manufacturer "for reasons sufficient to himself" without violating the law, so long as he acts individually and not in agreement with others, according to a recent decision of the United States Supreme Court, which nullifies an order issued by the Federal Trade Commission. The Raymond Brothers-Clark Company, Nebraska wholesale grocers, made purchases from the T. A. Snider Preserve Company, Illinois manufacturers. The Raymond Brothers-Clark Company discovered that the Snider company also was selling to the Basket Stores Company, another Nebraska corporation which does a wholesale grocery business but whose principal business is the conduct of a chain of retail stores. Thereupon the Raymond Brothers-Clark Company asked the Snider company to pay it a jobber's profit on the goods sold direct to the Basket Stores Company. The Snider company refused and the Raymond Brothers-Clark Company refused to purchase further from the Snider company. The Federal Trade Commission cited the Raymond Brothers-Clark Company on charges of restraint of trade and unfair competition and subsequently issued an order against it to desist from refusing to buy from a manufacturer who sold to another company. This order was resisted in the courts. The Federal Trade Commission was upheld by the Federal District Court, but this decision was reversed by the Circuit Court of Appeals. The Supreme Court decision affirms that of the Circuit Court of Appeals, declaring the action of the Raymond Brothers-Clark Company not in restraint of trade and not constituting unfair competition.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, New Equipment Available, Foreign and Construction News

The Romance in Shipping Machinery

The Secret of Breathing Holes—Conditions Met in South America and in India—Points About the Shipping of Big Turbines

By C. M. Ripley
General Electric Company, Schenectady

FOR many years it had been found that the shipments of American electrical machinery to foreign lands were damaged by rust, although they were perfectly protected from rain and storm. This rust evidently was produced by the moisture in the air, that is, the humidity. Various experiments were tried using special kinds of cloth, special coatings of tar, and in some cases an entire metal box of zinc or lead construction which appeared to be hermetically sealed. But these all failed of their purpose. In one instance a motor was totally inclosed in a zinc tank and soldered tight. Two years later it was opened and there were three quarts of water in the bottom of the tank.

Breathing Holes

Apparently, owing to jarring and vibration, some little crack or pinhole had opened up and the box had begun to "breathe." The dampness would condense against the cold machinery, and then in the daytime when the temperature rose the box would breathe out dry air. Thus, with the rising and the setting of the sun, moisture was carried into the box that was thought to be hermetically sealed. The shipping experts were baffled; they gave up the problem as hopeless until an electrical engineer advised that the boxes be made open instead of closed and that "breathing holes" should be provided so as to keep the temperature inside of the box practically the same as the temperature outside of the box. The shipping department conducted many experiments, and eventually a method was developed which finally and forever solved the problem.

Again the great generators from the London underground railroad were delivered free of rust, but it was found that the mice on shipboard had taken advantage of the breathing holes in the boxes and had eaten the insulation on some copper wire. So from that time on a wire screen or netting was tacked on the inside of each hole. The breathing holes are not made too close to the top or bottom or sides for fear water might wash into them. To provide against the possibilities of the boxes being laid on one side, thus making the holes on the top, a funnel-shaped shield is tacked on the inside of the box around the hole, and this shield or funnel traps the water and diverts it down the side of the box, away from the machinery. Shipping experts who have had unequaled opportunity to study these questions say that shipments of apparatus made long since and which may be still lying at the port of Vladivostok in Russia will be found as free from rust and other damage due to the elements as if they had been standing in the shops an equivalent length of time.

Expert packers have no difficulty in protecting machinery from rain and snow, wind and heat, or from the mist on the sea. This is as easy as for an ordinary citizen to wear a mackintosh or carry an umbrella. The rain and snow are excluded by tar-coated building paper strengthened by mosquito netting. This light, filmy mosquito netting is quite useful in adding strength to the tar paper and serves its purpose admirably. For packages that go to foreign countries an additional covering of what is known as carriage cloth is wrapped around the machinery itself and is held tight by strings and ropes so that no matter what position the machinery may be in, it is well protected.

Experience has shown that entirely different arrangements must be made for shipping electrical apparatus to South America, India, France and Alaska. Machines for the west coast of South America must be "dismembered" into numerous small packages of comparatively light weight because there are no wharves, piers or docks worthy of mention on the entire western coast. Besides, a burro cannot carry up into the Andes Mountains a package weighing over 170 lb., and a mule's limit is 350 lb.; so that the machines must be "knocked down" before being sent on their long and arduous journey.

Rigors of South America

Just think of the preparation necessary to insure safe delivery of the electrical machinery over the following route, for instance: By railroad to New York, by boat to South America, and from the boat unloaded into canoes. These canoes are paddled as close as possible to shore, and then the boxes or packages of carefully made machinery are tossed into the surf. Then they are dragged ashore and trucked to a railroad station and begin a journey of two or three or four days more, probably on an open or flat car to the end of the line near the foot of the mountain; then four days more in an open boat, with Aztec Indians or peons as pilots. And then, after the river ceases to be navigable to a boat, the Yankee motors and generators are loaded on the backs of mules for their long journey up the narrow, winding paths of the Andes Mountains.

Do you think that the Aztec Indian is careful to lower the packages of precious machinery gently from the mule's back to the ground? Our Indian friend is probably as tired as the mule and merely loosens the strap, allowing the box to fall to the ground, whether it be rocky or marshy, whether the sun be shining or the rain be falling.

To appreciate these difficulties, remember that salt water as well as fresh water has been encountered, that the machinery has risen from sea level in a tropic land to the snow-capped mountains of the Andes, and that after arriving at the location of

the power house it is likely to be left lying on the mountainsides for months before the engineers are ready for it. But the experts of American industry today have learned how to pack the machinery to defy breakage, rain and moisture, and they can guarantee in advance that the machinery will operate without a hitch.

Other problems must be met, even on the better developed parts of the west coast of South America. In some places machinery is hoisted from the boats and lowered into a lighter to be taken ashore. Regardless of its name, the Pacific Ocean has many a rough sea, and you must picture in your mind a load of several tons of generators or motors being lowered from the vessel to the lighter, and the lighter itself coming up on the crest of a wave with practically irresistible force. The size and weight of packages must be so limited that the men handling the derricks will be able to land the machinery safely in the lighter and will not permit it to go crashing through the bottom into the sea.

Elephant and Termite

In India crude trucks drawn by teams of oxen carry loads as heavy as 3 tons to 5 tons, while the elephants can haul 10 tons. In a recent installation of American machinery in India it required one complete year before the apparatus could be carried 250 miles into the interior by elephants. On this 250-mile journey to the Himalaya Mountains, where the water power was being developed by American machinery, it was found that many of the bridges had to be rebuilt in order to carry the heavy loads, the equal of which had never before passed into the heart of that country. A curious sight was witnessed when the Hindus organized committees of welcome, with bands of native musical instruments, to meet the Yankee engineers; for the story had been spread that the Americans were to introduce that weird god of lightning which would lighten labor and pierce the night of their wilderness country in the Himalaya Mountains.

In India, just as in South America, the jarring of loading and unloading must be guarded against; but, besides this, there is in India a different enemy of electric machinery who is most formidable, although he is only three-quarters of an inch long from stem to stern. This enemy is the dreaded termite.

If a box of machinery were left overnight unprotected on a truck, the next morning there would probably be nothing remaining of the entire shipment but the bare metal. The termite is an insect which feeds chiefly on wood and does not leave even as much as sawdust after he has completed his meal. On one occasion a row of telegraph poles was completely eaten up by these termites, and in forty-eight hours nothing was left but the wires and the glass insulators. Engineers have found that there are only three things which resist this insect, namely, stone, metal and the humble coat of tar. So all boxes that are sent to this section of India must be thoroughly coated—one might say thoroughly saturated—with coal tar, just as the workmen spread it thickly on the roof of a building.

Packing for Dog Sleds

Now turn from the elephants of India to the dog sleds of Alaska, at almost the opposite end of the earth. Electricity is needed in the frigid zones as well as in the torrid zone, and the dog sled of the Eskimo is the accepted means of transportation. In this case a thousand pounds is the limit in weight of each package in order that they may be effectively handled by a standard "dog train." A 1,000-lb. package is of such size that the men and the dogs are able to handle it easily.

So well does the shipping expert meet the peculiar local conditions of the dog sleds that special horns are provided on each package to assist the Eskimo in lashing it to the sleds. Thus the men of the shipping department must understand the customs and environment of the Hindus in the Himalaya Mountains, the Indians in the Andes Mountains and the Eskimos in the Yukon district of Alaska.

When the first turbine was built in 1902, to be shipped to Chicago, it caused great perturbation in shipping departments. Two railroad cars were broken in attempting to load one of the cases. The railroad company deliberated for a week before it could decide whether it could transport the turbine to Chicago, and a special train, requiring an expense of $1,000 in addition to the regular freight charges, was necessary to get this piece of apparatus to its destination. Now manufacturers are shipping turbines of 50,000 kw. capacity, instead of merely 6,000 kw. as a maximum.

Special cars of unusual strength, with increased depth, reaching down to within a few inches of the rail, and otherwise adapted for the peculiar variation in size, shape and weight of modern electrical machinery, have been provided. The art of fastening these large pieces of machinery to a freight car has been developed to a high degree of perfection. In a recent wreck on a Western railroad a car containing electrical apparatus was upset, but when the wreck was cleared it was found that the platform of the car and the apparatus were still integral, the platform having left the trucks, but remaining fixed immovably to the apparatus.

There are wonderful stories to be told of single turbines that require fifteen separate cars for shipping, of special cars carrying from 50 tons to 70 tons each, and of how the apparatus has been so nicely poised and balanced on the car that clearance between the sides of the tunnels or between the bottom of the bridges has been figured out to half an inch. In such nice calculations as these it has been necessary to abandon the use of wood for boxing, substituting the use of sheet metal to obtain a covering thin enough to avoid crashing into bridges or scraping the sides of tunnels in the Rocky Mountains, as either occurrence would probably wreck the entire train.

When the large generators for the Metropolitan Street Railway were to be shipped to New York City it was found that the loaded cars would be half an inch too high to pass under some of the bridges. It was, therefore, necessary to give the spring of the railroad cars a special compression at the factory in order to permit the cars to get through. This heroic method overcame the contention that "it can't be done."

Have You a Historical File of Trade Catalogs?

A STUDY is now being made by a special committee of the Special Libraries Association of the United States pertaining to trade catalogs, and information is desired as to what firms in this country keep a historical collection of trade catalogs. Information regarding this subject would be gratefully received by L. A. Armistead, librarian, Boston Elevated Railway, 31 St. James Avenue, Room 711, Boston 17, Mass.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

NORMAL business in the electrical industry is reported throughout the country this week, the exceptions being a decided improvement in New York and a slight lull on the Pacific Coast. The unusually prompt recovery from the first-of-the-year slump is well sustained. The general outlook is considered extremely good.

Electrical contractors believe that there is good promise of a larger building program this year than in 1923. The general price situation in electrical construction work is still not very good in New York, but it is better in the South and very satisfactory throughout the West. Housing is expected to lead in this construction program, with industrial and office building running second and third. The outlook in the material market seems to be very satisfactory, there being a strong price situation and an active demand, with buying in good balance. The labor condition also is fairly stable, and very few increases are expected.

Central-station buying continues strong in New England and marked improvement is reported in collections. In the New York district prices are strong, though jobbers and manufacturers are believed to be losing money on armored cable. Storage-battery sales are reported unusually active in the South, and there appears to be an overstock of conduit and cable in the Middle West, which gives promise of an early price reduction. Power company business is quiet on the Pacific Coast with railroad buying active. The continuance of open weather generally over the country still sustains the market for material used in central-station line construction.

Induction Motors Moving Slowly, Stocks Good and Prices Firm

INDUCTION motors are moving slowly at this time, but this is in keeping with the seasonal demand, giving manufacturers an opportunity to replenish depleted stocks in preparation for the peak demand which occurs later in the year. Stocks are good on both slip-ring and squirrel-cage motors. Squirrel-cage machines are more in demand, being favored on account of their lower cost and simplicity. Slip-ring motors are in demand only where necessary for higher torque or variable speeds and where required by the power companies.

Present deliveries are not so good as they were six to eight months ago, but they are better than three months ago, and are steadily improving, as manufacturers have taken steps to increase production to meet the demand, which is good and is not expected to drop. Deliveries on average induction motors up to 50 hp. are quoted by most manufacturers as stock, with shipments running four to six weeks in some cases where not in stock. In the larger sizes up to 100 hp. delivery can be made in four to twelve weeks, depending on the manufacturer and the type. Motors of 200 hp. and over may run up to eighteen weeks. Special motors are expensive to the manufacturer and delivery is usually not so good.

Hand compensators in general can be supplied on the same shipment as the motors with which they are to be used. Automatic starters are slow, but the demand has been slowly increasing, and manufacturers are increasing facilities to meet the demand and provide better deliveries. Many sales revert to the hand compensator on account of the difficulty in securing the automatic.

Since last August, when prices were generally increased about 10 per cent, there have been no price changes, and as the demand is not expected to drop no price revision can be looked for at the present time. There is every indication that prices will continue to be firm.

Building Industry Reports General Increase

THE building contracts let in the city of New York and northern New Jersey reached the highest point in November for any month in five years, according to a statement just issued by the F. W. Dodge Corporation. Contracts let in December showed an increase of 25 per cent over the previous December, although they were about 11 per cent less than in November.

Building contracts let in December showed an increase in New England of 27 per cent; in the Pittsburgh district, comprising western Pennsylvania, Ohio and Kentucky, 33 per cent over December, 1922; in the Southeastern States, 8 per cent over November; in the Northwest, 7 per cent over November and more than 100 per cent over December, 1922. The Middle Atlantic States showed a drop of 24 per cent from the previous December, although this was an increase of 3 per cent over the preceding month, and the Central West showed a drop from November of 9 per cent and from the previous December of 19 per cent. The Middle Atlantic States and the Central West were the only two sections to show a decrease from last year. The report further states that the 1923 increase over 1922 was surprising in view of all the conditions, and it seems unlikely that 1924 can better the 1923 record or even equal it.

As the sale of electrical equipment and materials of all kinds is dependent largely on the new buildings constructed, the present heavy demand for building equipment continues and should hold good for some time. Unusual activity is maintained in the building industry and all building construction lines are moving well.

European Economic Outlook Encouraging

INTERESTING evidence presented at the annual meeting of the Chamber of Commerce last week by Willis H. Booth of the Guaranty Trust Company, who is president of the International Chamber of Commerce, gives strong encouragement to the prospect for more stable business in Europe. Mr. Booth has recently returned from Europe after making a thorough study of the economic conditions in the various countries. He stated that business conditions and the general economic outlook are better than at any time since the signing of the peace treaty. England's present trouble he attributes to the unemployment doles that have tended to reduce immigration, which has taken care of her surplus population in former crises.

Wire Declines in New England—Collections Improving

A FEATURE of the New England market on Monday was a price drop of ½ cent per pound on weatherproof and slow-burning wire, other quotations on electrical supplies being generally steady. A tendency toward higher prices in pole-line hardware is rumored for early realization. Stocks are meeting current demands readily, and unusually open highways and rail routes are expediting deliveries at this season. Central-station buying of materials for outside construction continues in good volume, but the sale of interior wiring devices and material generally is normal. Industrial lighting improvements are causing a fair movement of reflectors and lamps, and there is a heavy demand for bracket types of domestic fixtures.

Collections with some exceptions are showing marked improvement over the past few weeks. Jobbers are handling a large volume of trade, and money is comparatively easy, notwithstanding unsettled industrial conditions. Such buying as the cotton textile mills engage in is small in volume, but payments are prompt for electrical supplies. Follow-up work is thoroughly done in contractor-dealer circles, and in Boston a better tone to this class of collections is reported. Utility purchases are large and settlements prompt.

Since the first of the year conditions have shown general betterment, although some organizations do not report striking gains. Careful picking of credit risks is apparent. Leading jobbers are obtaining settlements on the average in about sixty days, some houses running below and others above

this figure. Jobbers and manufacturers base an optimistic outlook on the prospect of constructive tax legislation in state as well as national governmental circles.

Railroad Business Strong on Coast—Power Field Quiet

THE electrical business on the Pacific Coast has been rather quiet this week, probably as a reaction to poor country business, due to the long drought from which this section had been suffering. Power company orders have dropped to a few maintenance items, the last sizable purchase being two car loads of strain insulators for the central valleys. Railroad business continues excellent, however, not only for special requirements such as dispatching cable and dry batteries, but also in the full line of assorted electrical wiring supplies. Several large lamp-cord and socket orders were reported last week for incorporation in manufactured products.

Bare copper wire decreased 50 cents in price, which came as rather a surprise. Weatherproof wire still stands at $22 per 100 lb. for three-braid base quantities. These lines are slow-moving at present. Retail trade among electrical dealers is feeling a natural reaction from the holidays, but certain flashlight items and a better radio business are filling this seasonal valley. Jobbers' salesmen are now actively obtaining fan contracts for the approaching season. The average contract reported is for twenty-five fans based on a year's purchase, showing an average reduction of 5 per cent over last year's prices.

Total figures are beginning to come in on 1923 range sales. Fully two thousand were sold in northern California alone. The business is being well handled and shows promise of continued development this year.

General Improvement in the New York District—Radio Strong

BUSINESS in the New York district continues to show improvement, with buying conservative. There is evidence that buyers are practicing a strict economy in the apparent belief that this is the surest means of insuring a continuation of prosperity.

The demand for radio material is exceptionally good and is as strong as, if not stronger than, before the holidays. The armored-cable and tape markets continue to be highly competitive and manufacturers and jobbers are apparently losing money, some manufacturers having been compelled to close their plants. Tape prices have been seesawing, but in general remain constant, even though cotton has increased. Conduit and other materials used in fireproof building construction and also the general supply lines are steady, the demand continuing good, and there is no observable tendency toward any change in prices. Appliance business is quiet, a natural condition at this season. Manufacturers and jobbers are endeavoring to increase sales, co-operating in extensive campaigns on vacuum cleaners and washing machines. Increased radio business has swelled the demand for dry cells. Flashlights are enjoying good sales and have clearly passed out of the "toy" stage and established themselves firmly in the staple market.

Preparations are well under way for the coming fan season, and there is an indication that manufacturers and jobbers are anticipating requirements. Prices will remain the same as last year and a normal increase in business is expected.

Normal Business Restored in the Southeast—Battery Sales Good

ALL indications are that activities in the supply lines have again returned to normal in the Southeast, jobbers reporting that their January business to date is very good and in some instances is only a little less than the December volume. Motors and industrial apparatus have not become active as yet, but all indications are for a revival in this line in the very near future, to be occasioned by the extension of high-tension transmission into virgin territory. The demand for storage batteries has been and continues to be very active. The sales of batteries for farm-lighting outfits reached a high-water mark last year and should do even better this year with the steadily increasing use of the outfits.

The adoption by the city of Atlanta of the new National Electrical Code with some additions thereto, thus requiring all wiring, except single-circuit jobs, to be installed in conduit or in armored conductor, will result in a reduction in the local demand for materials used in knob-and-tube installations and a consequent increase in the demand for conduit and armored conductor. The new code also requires the use of universal-type safety switches in all capacities of 30 amp. and over and meter trim for all capacities. This change will work no hardship on the local dealers as in most instances they have been able to dispose of their stocks of the type of switch in use prior to the new ruling.

Middle West Quiet — Oversupply of Conduit and Cable

THE electrical trade experienced a rather quiet week. There have been no remarkable changes in prices this week and stocks in general are normal, as is demand except for conduit and armored cable. There appears to be an oversupply of flexible armored cable on the market, as manufacturers are offering this commodity at the carload rate of $41.72 on any quantities delivered at Chicago. Conduit appears to be very plentiful, as manufacturers are still offering remarkably prompt shipments, although the time is a little longer than several weeks ago. Manufacturers of this commodity have booked considerable quantities of conduit, and it appears that there may be an advance in price. Last week it was definitely stated that a price advance would soon go into effect, but this was not announced. It appears that several manufacturers using this inducement had obtained an unusual amount of business before the conference of manufacturers was held, and those who did not solicit business on this basis would not agree to an advance in price until they had booked sufficient quantities to protect their trade. It would seem, therefore, that as soon as the other manufacturers have obtained the necessary tonnage an increase will be in order. With the steel mills working at an announced capacity of 85 per cent of their tonnage, it is reasonable to expect some increase.

Central-station purchases of pole-line hardware were very good last week. Several large orders for various types of hardware were placed. A good quantity of poles were bought by central-station companies.

There has been a shortage of 35-ft. poles, and it does not look as though this condition would change for some time, although most of the pole producers report a rather good season so far. One manufacturer of motors reduced the price of ¼-hp. and ⅓-hp. motors, asserting that increased manufacturing facilities enabled them to pass on the saving to the consumer.

The Metal Market

ALL non-ferrous metals have advanced in price for the first time in several weeks. Recently the demand for copper was small, although prices were low until Saturday, when a large number of inquiries were placed. With the placing of orders on Monday most of the metal then offered at $12.50 was absorbed, with a gradual strengthening of the price to 12⅝ cents, then to 12¾ cents, at which level most of the important tonnage was booked with some sales at 12¾ cents. However, the general price level may be said to be 12¾ cents. Export demand has also increased.

NEW YORK METAL MARKET PRICES

	Jan. 15, 1924 Cents per Pound	Jan. 23, 1924 Cents per Pound
Copper, electrolytic	12.45	12.62½ to 12.87½
Lead, Am. S. & R. price	7.90	8.00
Antimony	10.00	10.25 to 10.50
Nickel, ingot	26.00 to 30.00	26.00 to 30.00
Zinc, spot	6.675	6.85
Tin, Straits	49.25	51.00
Aluminum, 98 to 99 per cent	27.50	27.50

Lead advanced from 7.90 cents to 8 cents on Friday, January 18, with the demand continuing excellent, the cable and battery business being extremely active. The demand for zinc has been fair with the price gradually increasing. Galvanizers, who have been the chief buyers, are expected to come into the market again. Tin continues to advance, with spot metal scarce and likely to be for the rest of the month.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

National X-Ray Changes Name and Completes New Building

The National X-Ray Reflector Company, X-Ray Reflector Company of New York, Inc., and Luminaire Studios, Inc., announce that they will hereafter combine under the group name of Curtis Lighting, Inc., continuing to function in exactly the same manner as in the past, with the same sales policies, organizations and resident engineers in all principal cities.

A six-story office and factory building has just been completed by this company at 1119 West Jackson Boulevard, Chicago, at a cost of half a million dollars, with a quarter of a million square feet of floor area, which will afford greatly increased engineering and manufacturing facilities.

35,000-Kw. Turbo-Alternator Ordered from Allis-Chalmers

The Allis-Chalmers Manufacturing Company, Milwaukee, has received an order from the Public Service Company of Northern Illinois, Chicago, for a 35,000-kw. 90 per cent power-factor turbo-alternator unit designed for 350 lb. steam pressure, 240 deg. superheat, 29 in. vacuum, 12,000 volts, 60 cycles, three-phase. With this unit the Allis-Chalmers Company will also furnish a 52,000-sq.ft. surface condenser and auxiliaries.

This equipment will be installed in the new Waukegan (Ill.) station of the Public Service Company of Northern Illinois, where there is already in operation one 25,000-kw. Allis-Chalmers turbo-alternator and a surface condenser purchased early in 1922. This order marks the entry of the Allis-Chalmers company into the development of high-capacity turbines.

New Westinghouse Lamp Factory in Jersey

The Westinghouse Lamp Company, Bloomfield, N. J., has opened its new plant at Belleville, N. J. The building is of brick, two story and basement, of the mill type, covers a floor space of 115,000 sq.ft., and has an annual production capacity of 110,000,000 lamp bases of all types. The lamp bases for all Westinghouse lamp factories will be made at this plant.

Many modern conveniences are installed for employees, including an air-conditioning system for cooling in summer and heating in winter. The plant contains its own modern oil-burning power-generating equipment and is supplied with breakdown service from the utility company. A feature of this plant is that it is the most thoroughly automatic of its kind. It contains automatic machinery costing nearly $500,000, and requires only about 160 employees to obtain maximum production.

Betts & Betts Corporation Changes Sales Organization

The Betts & Betts Corporation has discontinued its regular sales force, retaining but two of the oldest salesmen, S. B. Johnson in New York and V. H. Walker in Philadelphia. The firm has established a series of manufacturers' representatives as follows:

F. Robert Schwartz & Brother, New York; W. A. McDonnell, St. Louis; J. S. Jacobson Company, Chicago; Electrical Specialties Company, Detroit; Panama Lamp & Commercial Company, San Francisco; Detweiler Bell Company, New Haven and Boston; Walker-Lilly Electric Company, Louisville; Robertson Sales Company, Birmingham; W. A. Bittner Company, Pittsburgh; Coffin-Perry Company, Columbus, Ohio, and Globe Electric Supply Company, Denver. The first five representatives carry a warehouse stock for local delivery, and it is hoped before June 1 to have local delivery stocks in the hands of every representative.

Westinghouse Gets Large Motor Order

The Westinghouse Electric & Manufacturing Company has received one of the largest orders for electric motors placed in recent years in the wire industry in connection with the forthcoming increased electrification of the American Steel & Wire Company's works at Worcester, Mass. About 12,000 hp. in 440-volt and 550-volt, three-phase, 60-cycle type CS motors ranging from 1 hp. to 250 hp. in rating are included, together with oil-circuit-breaker equipment of high rupturing capacity for both high-tension and low-tension circuits.

Three 27,000-Kva. Generators Ordered from General Electric Company

The General Electric Company has received an order from the Pacific Gas & Electric Company for three generators for its Pit No. 3 power house, on the Pit River, California. These generators will be of the vertical type with a rated capacity of 27,000 kva. each at 11,000 volts, three-phase, 60 cycles, and will be furnished with direct-connected 250-volt exciters.

New Diesel-Electric-Driven Tanker

The General Electric Company has received an order from the Atlantic Refining Company of Philadelphia for electric propelling equipment for converting to Diesel-electric drive one of its bulk gasoline carriers for coastwise service. Two 225-hp. Ingersoll-Rand Diesel engines will be used, each driving one 155-kw. main generator and a 26-kw. auxiliary generator. The two generators will be connected in series and will drive a single 370-b.-hp. propelling motor. Control will be of the Ward-Leonard or voltage type, arranged for operation from the pilot-house only. When the craft is in port one of the main generators will be used for furnishing power for driving the cargo pumps.

Pacific Coast Steel Company Gets Tower Contract

The Pacific Coast Steel Company of San Francisco has been awarded the contract for furnishing the city of San Francisco with the steel transmission towers for the Moccasin Creek hydro-electric development of the Hetch Hetchy project. The order calls for the furnishing of more than 500 towers at a cost of $275,000.

Philadelphia Firm Moving Entire Plant from Chicago

John Sidebotham, Inc., Frankford, Philadelphia, has purchased the entire insulating tape plant of the Belden Manufacturing Company, Chicago. Contractors are now dismantling the Belden plant preparatory to shipping the equipment East, when it will be re-established in quarters adjacent to the present plant. The Sidebotham firm specializes in the manufacture of electrical tape and last year observed its centennial. The firm has branch offices in many parts of the country, including Detroit, Chicago, St. Louis and San Francisco.

Rapid Development of High-Tension Insulator Testing Service

The demand for insulator testing equipment and allied service is rapidly increasing in different parts of the country, according to F. C. Doble, president Doble Engineering Company, Cambridge, Mass. His company's business is trebling annually, Mr. Doble says, and there is also much interest in high-tension telephone apparatus. More than thirty insulator testing contracts were renewed in the past year. All expiring contracts for insulator testing service have so far been renewed and in most cases have been increased in scope. Some of these are in their third year. At the annual meeting, January 17, F. L. Piper, Manchester, N. H., was elected vice-president and P. W. Davis, Cambridge, treasurer of the company.

Canadian Combines with American General Electric Company

The Canadian General Electric Company at a meeting last week approved plans for transferring that property to the American General Electric Company. The formalities for the completion of the merger will be settled by February 15. Dividends will be paid on all common stock of the Canadian Company from January 1 to date of transfer, after which dividends will commence on new preferred shares. The sales of the Canadian company are between ten and twelve million dollars per year.

The Interflash Signal Corporation, 120 Broadway, New York City, manufacturer of highway and railroad electric signal devices, has leased a portion of the building at Plane and Augusta Streets, Newark, for a new plant, primarily for the manufacture and assembling of parts.

The Westinghouse Electric & Manufacturing Company, East Springfield, Mass., has received a $1,500,000 order from the Radio Corporation of America, which includes radio receiving sets of new design. Work will start immediately and the operating force at the East Springfield plant will be increased.

The Riley Engineering Company of Canada, Ltd., a division of the Underfeed Stoker Company of Canada, Ltd., Toronto, has been granted an exclusive license for the manufacture and sale of the Harrington forced-blast traveling grate stoker throughout the Dominion.

The Risdon Manufacturing Company, Naugatuck, Conn., manufacturer of electrical sockets and fuse shells, has increased its capital stock from $800,000 to $1,000,000.

The General Electric Company nas purchased a tract of five acres of land at Los Angeles, improved with a large building on a portion of the site, and will remodel and equip the structure for a new distributing plant. A seetion of the building will be used for general service and repair operations. At a later date it is purposed to use the other part of the land for the erection of a large branch assembling and manufacturing plant for Southern California business. At its Bridgeport (Conn.) works, Boston Avenue and Bond Street, the company is completing plans for two additions, comprising a one-story building to be used as a machine shop and a two-story building for general manufacture.

The Lincoln Washing Machine Company, Detroit, is now manufacturing a new type of electric washer called the "Lincoln Ring-Vac."

The Champlain Electric Company has been recently organized to sell electrical supplies, with offices at Pittsfield, Mass., and Burlington, Vt. The capitalization is $50,000 and the incorporators are: Malcom G. Clark, Burlington, president; Douglas G. Clark, Burlington, and George H. French, Pittsfield, treasurer.

The Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., reports the appointment of the Auto-Electric Sales Company, 136 Federal Street, Boston, as its New England representative, to succeed James H. Healey & Company. C. H. Wallis & Company, Syndicate Trust Building, St. Louis, who now represent the Central Tube Company, and Eastern Tube & Tool Company, are also handling the sale of Trumbull-Vanderpoel material in the states immediately west of the Mississippi.

The Killark Electric Manufacturing Company, St. Louis, announces a change in its sales representatives in New York. George C. Knott, 67 Park Place, New York City, is now representing this company in New York State and Greater New York for the Killark line of bell-ringing transformers, conduit fittings, inclosed fuses, etc. Mr. Knott was formerly of Hatheway & Knott, 16 Hudson Street, New York, who have been the Killark Eastern sales representatives for the past eight or ten years.

The Edison Electric Appliance Company, owing to increased business in the Southern territory, has found it necessary to double the size of its Southern office, which is in Atlanta. On January 15 the company's office was moved to 184 Spring Street, where much greater facilities are provided.

The Chain Belt Company, manufacturing conveying equipment and power-transmission machinery, has opened branch offices and warehouses in San Francisco and Los Angeles in addition to the three direct factory warehouses and branches recently opened in Spokane, Seattle and Portland.

New Equipment Available

Short Descriptions of New Apparatus and Accessory Equipment of Interest to the Electrical Industry and Available from Manufacturers and Announcements of New Lines

Automatic Motor Starter

An inclosed automatic starter of the primary resistance type, known as CR-7056-D1, has been developed by the General Electric Company for starting polyphase squirrel-cage induction motors under light load. The resistance of this starter is proportioned to give an inrush current of three and a half times the normal full-load motor current, permitting the motors to develop at least 50 per cent full-load torque in starting. The starters are equipped with a single-step resistor, equal parts of which are connected in each phase. The switching elements consist of a starting contactor, a running contactor and a time-limit accelerating relay whose action is retarded by an alternating-current magnetic drag. Overload protection is provided by a thermal overload relay. The time interval of the closing of the accelerating relay can be changed from approximately three seconds to eight seconds.

Automatic Spot Welder.—The American Electric Fusion Corporation, 1906 North Halsted Street, Chicago, has placed on the market a spot-welding machine in which the current is turned on and off and the pressure applied automatically. A repulsion motor drives the welder through gears at the rate of 110 spots per minute.

Lightning Arrester Choke Coil.—The General Electric Company has developed a strongly braced cylindrical type of insulated choke coil for lightning arresters, consisting of a coil of bare copper wire securely braced for the full coil length at three points in the circumference. The coil is mounted on insulators which are supported on a channel iron. The indoor coils have standard General Electric busbar insulators, and the outdoor type are equipped with standard pintype insulators.

Kitchen Lighting Unit.—An inclosed dustproof kitchen lighting fixture, designated as type XCK, has been developed by the Mitchell Vance Company, Inc., 503-511 West Twenty-fourth Street, New York City. The unit is designed for a 150-watt lamp, though in small rooms a 100-watt lamp may be used. It is supplied either with or without a self-contained pull-chain switch.

Pyrometer.—A pyrometer consisting of a thermocouple and suitable leads and meter for use in measuring the temperature of metals while being melted in pots or crucibles has been brought out by August Zanbitz, 95 Cliff Street, New York, N. Y. The meter consists of an aluminum bobbin wound with fine insulated wire the terminals of which are connected to two spiral hairsprings. The springs thus carry the current from the thermocouple and also hold the instrument needle.

Resistor Grid.—To assist in the standardization of resistor grids, the General Electric Company has developed a type BG railway resistor which is interchangeable with other resistors on the market. The unit consists of a sheet-steel punched-end frame with sufficient holes to enable its support on the same bolt-hole centers as other generally used resistors. The convolutions of this resistor are shorter than in the CG and RG types, the grids are stronger and less likely to break or warp and the number of contacts is reduced to half. The resistor is arranged for mounting with standard porcelain supporting bolt insulators.

New Trade Literature

AIR HEATER.—The Combustion Engineering Corporation, Broad Street, New York City, has issued bulletin AH-1, covering its "C E C" air heaters.

PORTABLE INSTRUMENTS. — Bulletin No. 210 issued by the Roller-Smith Company, 233 Broadway, New York City, covers its direct-current portable instruments, including ammeters, milliammeters, voltmeters, etc.

COMMUTATOR STONES.—The Martindale Electric Company, Box 35, Lakewood Branch, Cleveland, is distributing a circular covering its commutator stones.

SOOT BLOWER.—The Bayer Company, 4,067 Park Avenue, St. Louis, has published a folder covering the "Bayer" type S soot blower.

RECORDING AND CONTROLLING INSTRUMENTS. — Bulletin No. 96-1 issued by the Foxboro Company, Inc., Foxboro, Mass., covers the various types of the "Foxboro" indicating, recording and controlling instruments.

SMALL MOTORS.—The Galvin Electric Manufacturing Company, 3314 South Broadway, St. Louis, has issued price book No. 2, covering its complete line of fractional-horsepower motors from $\frac{1}{70}$ hp. to $\frac{3}{4}$ hp. inclusive, repulsion induction motors from $\frac{3}{4}$ hp. to $\frac{1}{2}$ hp. inclusive, and two-phase and three-phase motors from $\frac{1}{4}$ hp. to 1 hp. inclusive.

SWITCHING AND PROTECTIVE EQUIPMENT.—The Hi-Voltage Equipment Company, Cleveland, has issued catalog No. 3, covering its switching and protective equipment for outdoor substations, including air-break switches, lightning arresters, disconnecting switches, expulsion-type fuses and bus supports, etc.

ELECTRIC RAILWAY SIGNALS AND CROSSING BELLS.—The American Insulating Machinery Company, Fairhill and Huntingdon Streets, Philadelphia, is distributing a new catalog covering the "Aimco" electric railway signals and crossing bells.

REFRIGERATING MACHINE.—Bulletin No. 70 issued by the York Manufacturing Company, York, Pa., describes and illustrates the "York" self-contained refrigerating units for meat markets, restaurants, etc.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in Copenhagen, Denmark (No. 8,875), for electric advertising signs.

Purchase and agency is desired in Bilboa, Spain (No. 8,892), of meters for electric lighting and electric power.

Purchase and agency is desired in Sydney, Australia (No. 8,909), for electrical novelties.

Purchase is desired in Christiania, Norway (No. 8,885), for radio materials for amateur use.

An agency is desired in Stockholm, Sweden (No. 8,867), for dry batteries containing "mangan."

The following inquiries have been received by the Philadelphia Commercial Museum, which will furnish names and addresses of inquiries to any one desiring them and mentioning the number given: Parties in Valetta, Malta (No. 41,619), are interested in the following articles on a wholesale scale: Electric batteries and other electrical goods, wireless-telephone apparatus, gas fixtures, meters, etc. Parties in Karachi, India (No. 41,652), would like to communicate with manufacturers of electrical novelties, pocket lamp batteries, etc.

PROPOSED HYDRO-ELECTRIC PROJECTS IN CONNECTION WITH ELECTRIFICATION OF RAILWAYS IN FRANCE. —Plans are being considered for utilizing the water power of the Dordogne River and the greater and lesser Rhue Rivers, which will involve the construction of a dam, 375 ft. high, on the Dordogne River at Chambon. Three other dams will be built on the Dordogne, two in the Argentan district and one at Brivezae. This project is included in the concession granted to the Compagnie d'Orléans for the electrification of railways.

NEW ELECTRIC PLANT PROPOSED FOR FARTURA, BRAZIL.—The Sociedade Anonyma Companía de Forca e Luz de Fartura has been organized. A. T. Haeberle, American Consul, São Paulo, states, to install and operate an electric lighting system in the city of Fartura, State of São Paulo, Brazil. It will also deal in electrical equipment. The main office of the company will be in the city of São Paulo.

New Incorporations

THE WISCONSIN POWER & LIGHT COMPANY, Madison, Wis., has been incorporated with a capital stock of $5,000 by Arnold R. Peterson, Alfred T. Flint and D. E. Longan, all of Madison. The company proposes to sell electricity to the city of Madison and other municipalities.

THE LIGHT, ICE & WATER COMPANY, La Grange, Tex., has been incorporated with a capital stock of $115,000 by J. H. Killough, S. C. Lowry, Paul Sladzyk and George F. Lynert.

THE KENTUCKY NORTHERN POWER COMPANY, Frankfort, Ky., has been chartered with a capital stock of $50,000 by Samuel S. Tescher, Henry A. Mansfield and others.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WATERTOWN, MASS.—Bids will be received by the commanding officer, Watertown Arsenal, until Jan. 30, for two electric motors.

GRISWOLD, CONN.—The Eastern Connecticut Light & Power Company, Plainfield, is planning to build a new local power house, to cost about $40,000.

MANCHESTER, CONN.—The Manchester Electric Company has been awarded a contract by the city for the installation of a police signal system, Gamewell type.

TORRINGTON, CONN.—The Torrington Electric Light Company plans to erect a generating station on Franklin Street.

WATERBURY, CONN.—The construction of a new power house is under consideration by the Waterbury Lumber Company.

Middle Atlantic States

AVON, N. Y.—The Livingston-Niagara Power Company has applied for permission to extend its transmission lines into the towns of West Bloomfield and Richmond to furnish electrical service.

BUFFALO, N. Y. — An electric power plant and electric equipment shop will be installed in the proposed vocational school to be erected in the Kensington section, for which an appropriation of $550,000 has been approved.

CATSKILL, N. Y.—The Upper Hudson Electric & Railroad Company has been granted permission to extend its transmission lines into the towns of Jewett and Lexington, which at present have not electrical service.

INDUSTRY, N. Y.—Bids will be received by Mrs. Warham Whitney, president board of managers, State Agricultural and Industrial School, Industry, until Feb. 13 for construction, heating, sanitary and electric work in connection with rebuilding hospital at the above institution.

JAMESTOWN, N. Y.—A committee has been appointed by the Chamber of Commerce to make investigations relative to the installation of an ornamental lighting system in the business district.

MOUNT VERNON, N. Y.—Extensions to the new ornamental lighting system is under consideration by the City Council.

RAY BROOK, N. Y.—Bids will be received by Dr. Frank Erdwurm, president, board of trustees, State Hospital for the Treatment of Incipient Pulmonary Tuberculosis, Ray Brook, until Jan. 31 for construction, heating, sanitary, electric and refrigerating work of storehouse and cold-storage building for the above institution.

SPRINGVILLE, N. Y.—The Town Council has appropriated $42,000 for improvements to the municipal electric plant, including the installation of new equipment.

WORCESTER, N. Y.—The Public Service Commission has authorized Harry Shafer, owner of the local electric plant, to transfer his franchise and plant to Lewis R. Brown, Chatham. The new owner proposes to improve and develop the property.

BENTON, PA.—The Pennsylvania Power & Light Company, Allentown, has acquired the property of the Benton Hydro-Electric Company. Extensions will be made in the plant and transmission lines.

EASTON, PA.—The Pennsylvania Edison Company is planning to build a hydro-electric plant on the Delaware River, near Reigelsville.

McKEESPORT, PA.—Bids will be received until Feb. 11 at the office of the City Clerk for an addition to filtration plant, including two motor-driven centrifugal pumps of 3,000,000 gal. daily capacity, two pumps of 7,500,000 gal. daily capacity, electrical work, including wiring, switchboard, etc. Hudson & Myron, Wabash Building, Pittsburgh, are engineers.

MOUNT CARMEL, PA. — The Pennsylvania Power & Light Company is planning to build a large switching station in Mount Carmel near the power station of the Pennsylvania Colliery, to cost about $250,000.

PHILADELPHIA, PA.—Louis Burk has filed plans for the construction of a power house at his meat-packing plant, Third and Thompson Streets, to cost $75,000.

WILLIAMSPORT, PA. — The Citizens' Electric Company has been acquired by new interests. Plans are being considered for extensions to the system.

BALTIMORE, MD. — The United Railways Company has preliminary plans for the construction of a number of automatic substations in connection with improvements to be made during 1924, to cost about $1,750,000.

DANVILLE, VA.—Extensions are contemplated to the municipal electric light plant, including the installation of a 3,125-kva. turbine, condensing equipment, etc., to cost about $125,000.

PORTSMOUTH, VA.—Plans for the proposed local plant for the manufacture of railroad car wheels to be erected by the Southern Wheel Company, St. Louis, include a power house to cost about $100,000.

North Central States

CARO, MICH.—The Great Lakes Power Company contemplates extensions and improvements to its local plant and extending its transmission line from Sandusky to Wilmot and from Carsonville to Bad Axe.

CINCINNATI, OHIO.—The City Council is considering extensions to the ornamental street-lighting system.

MARYSVILLE, OHIO.—The Ohio Edison Company has secured a street-lighting contract from the city and will make extensions and improvements, including the installation of additional 250-cp. units.

ATTICA, IND.—The Attica Electric Company is negotiating for the purchase of the properties of the Attica Electric & Power Company, Newtown Electric Light Company and Hillsboro Power Company. It is proposed to consolidate the systems and make extensions to transmission lines.

EVANSVILLE, IND.—The Southern Indiana Gas & Electric Company has applied for permission to issue $750,000 in notes, part of the fund to be used for extensions.

JEFFERSONVILLE, IND. — The Interstate Public Service Company plans to erect an electric transmission line from Jeffersonville to Bedford, via Scottsburg, a distance of about 65 miles.

ALMA, WIS.—A petition has been presented to the City Council requesting a rearrangement of the street-lighting system in the business district.

MARSHFIELD, WIS. — The Municipal Electric Light Department is considering extending the lines of the municipal electric system to the town of McMillan, 3 miles, to furnish electricity there.

MONROE, WIS.—Plans have been completed by the Wisconsin Utilities Company to replace the present arc-lamp street-lighting system with incandescent lamps.

MUSCODA, WIS. — Arrangements have been made by the City Council with the Interstate Light & Power Company, McGregor, Iowa, to supply additional electric-

ity to the municipal electric light plant. The company plans to extend its transmission line from Blue River to Muscoda, a distance of 8 miles.

PLATTEVILLE, WIS.—The installation of an ornamental lighting ssytem in the business district is under consideration by the City Council.

WAUPACA, WIS.—The Council has approved the proposal to install additional street lamps in various parts of the city.

WAUSAU, WIS.—The Wisconsin Valley Electric Company contemplates the construction of three hydro-electric plants on the Wisconsin River at Lower Grand Father Falls, Trappe Rapids and Bill Cross Rapids.

LITTLE FALLS, MINN.—The Minnesota Power & Light Company, Duluth, is reported to have acquired the property of the Little Falls (Minn.) Water Power Company and also has purchased the Blanchard Rapids power site on the Mississippi River, 8 miles south of Little Falls, from the Pike Rapids Power Company for additional hydro-electric development. Work will begin at once on the construction of a hydro-electric plant at Blanchard Rapids, with an initial capacity of 18,000 hp. and ultimately 27,000 hp.

WILLMAR, MINN.—The Common Council has authorized plans for improvements to the municipal electric system. Toltz, King & Day, Inc., Pioneer Building, St. Paul, are architects and engineers.

BAGNELL, MO.—Plans are under consideration by Walter Gravens and associates for the construction of a 100-ft. dam, to develop 50,000 hp.

HIGGINSVILLE, MO.—The City Council is considering the installation of an ornamental lighting system on Fairground Avenue.

GRAND FORKS, N. D.—The City Council is considering the construction of a hydro-electric plant on the Red River.

QUINN, S. D.—W. F. Bronson plans to rebuild his local light and power plant, recently destroyed by fire.

GEUDA SPRINGS, KAN.—Bonds have been voted for the installation of an electric distribution system and the erection of an electric transmission line.

LEON, KAN.—Bonds to the amount of $32,000 have been voted for the installation of an electric distributing system, street lamps, etc., and erecting a transmission line from here to Augusta.

Southern States

BRYSON CITY, N. C.—Bonds to the amount of $100,000 have been authorized for the construction of a municipal electric plant.

GREENSBORO, N. C.—The Southern Milk Products Company contemplates the construction of a power house at its proposed local plant, to cost about $150,000.

RHODHISS, N. C.—The construction of two electric power plants, to cost about $5,000,000, is under consideration by the Southern Power Company, Charlotte. One will be located at Rhodhiss and the other at Duncan, S. C. Both plants will have an output of 40,000 hp. each. W. S. Lee, Charlotte, is chief engineer of the company.

COLUMBUS, GA.—The Columbus Electric & Power Company has filed with the Federal Power Commission a notice of its intention to build a dam and power plant at Bartlett's Ferry, about 16 miles above Columbus. The plans provide for an ultimate development of 60,000 kw. The initial installation will consist of two 15,000-kva. units.

CORNELIA, GA.—The property of the Wofford Shoals Light & Power Company is reported to have been acquired by the Georgia Railway, Light & Power Company, Atlanta.

WAYCROSS, GA.—The Municipal Service Company, Philadelphia, has acquired the property of the Ware County Light & Power Company. Improvements and extensions are contemplated to the system.

BAYBORO, FLA.—The Pinellas County Power Company is planning to build an electric power plant here, to cost about $1,500,000. The initial installation will develop 6,000 kw. The present 6,500-kw. station will ultimately be used for the main substation. Oil will be used for fuel. The General Engineering & Management Corporation, 141 Broadway, New York City, is in charge.

JACKSONVILLE, FLA.—Work will begin on extensions to the street-lighting system in the residential districts as soon as the weather will permit, for which $2,000,000 in bonds was voted last June.

GALLATIN, TENN.—Bids will be received by the Mayor and Board of Aldermen until Feb. 7 for improvements to waterworks, including four centrifugal pumps and motors. B. H. Klyce, Fourth and First National Bank Building, Nashville, is engineer.

WAVERLY, TENN.—Extensions contemplated by the Tennessee Utilities Company, Inc., during 1924, include the erection of a 12-mile transmission line to serve adjoining towns and installing a 10-ton to 12-ton ice plant with cold-storage facilities.

FLORENCE, ALA.—Bids will be received at the United States Engineer office, Florence, until March 1, for four hydraulic turbines each of 35,000 hp., with governors. For details see Searchlight Section.

FLORENCE, ALA.—Bids will be received at the United States Engineer Office, Florence, until Feb. 5 for furnishing and erecting electric traveling cranes of 150 tons capacity in the power house at the Wilson Dam on the Tennessee River. For details see Searchlight Section.

BETHESDA, ARK.—The Batesville White Lime Company, it is reported, contemplates the construction of a power house at its properties, to cost about $100,000.

FORT SMITH, ARK.—The Monol Window Glass Company contemplates rebuilding its local glass-manufacturing plant, including power house, which was destroyed by fire some months ago. The loss is estimated at $175,000.

HELENA, ARK.—The Arkansas Utilities Company contemplates extensions and improvements to the local electric and gas plants, to cost from $75,000 to $100,000.

TEXARKANA, ARK.—The Southwestern Gas & Electric Company is considering extensions and improvements, to cost about $200,000.

BATON ROUGE, LA.—The Texas Chemical Company, Houston, Tex., plans to build a power house at its proposed local plant, to cost $700,000.

GIBSLAND, LA.—Bids will be received by the city of Gibsland until Feb. 5 for improvements to electric plant and waterworks, including one generator and switchboard panels, thirty street lamps, insulators, etc.; two centrifugal pumps with motors, piping, etc. E. T. Archer & Company, Merchants' Building, Shreveport, are engineers.

CUSHING, OKLA.—The Minnesota Electric Light & Power Company contemplates improvements to its local distributing system.

TULSA, OKLA.—The Oklahoma Union Railway Company contemplates the construction of a power house at its proposed local car repair shops, to cost in excess of $90,000.

WAYNOKA, OKLA.—The Council is considering an issue of $28,000 in bonds for extensions to the municipal electric plant and distribution system. J. D. Bomford Enid, is engineer.

AUSTIN, TEX.—The Consumers' Ice Company contemplates installing electrically driven machinery in its plant at Fourth and Red River Streets.

BROWNWOOD, TEX.—The Gulf, Colorado & Santa Fé Railroad Company contemplates the construction of a power house at its local rock quarries.

KAUFMAN, TEX.—The City Council has contracted with the Texas Power & Light Company to furnish electrical service here. The company is erecting a high-tension line from Terrel to Kaufman, which it will extend to Edgewood and other towns which have also entered into contracts with the company for electricity.

TEXARKANA, TEX.—The Southern Ice & Utilities Company contemplates extensions and improvements to its electric and ice manufacturing plant, to cost about $250,000.

WILLS POINT, TEX.—Plans for a municipal electric plant have been abandoned and electric service will be furnished by the Texas Power & Light Company.

Pacific and Mountain States

EVERETT, WASH.—Permission has been granted to the Delta Electric & Water Company to build a hydro-electric plant on Pilchuck Creek in Snohomish County, to develop about 550 hp. The cost is estimated at about $200,000.

PORT ANGELES, WASH.—The Northwestern Power & Manufacturing Company has applied to the Supervisor of Hydraulics for permission to divert 1,300 cu.ft. water from the Elwha River, near Port Angeles. The present plans provide for a development of 20,000 hp., to cost about $1,600,000.

SEATTLE, WASH.—The City Council is considering an appropriation of $116,000 for extensions and improvements in the street-lighting system. J. D. Ross is superintendent of the lighting department.

SEATTLE, WASH.—The Puget Sound Power & Light Company plans an expenditure of $5,000,000 in west Washington during 1924. The work will include an addition to the White River power plant, to develop 23,000 hp., at a cost of $1,000,000; new transmission and distribution lines and substation improvements, $2,500,000, and miscellaneous improvements, $1,000,000. Will start preliminary work on the Baker River project, which will ultimately cost several millions dollars.

SALEM, ORE.—The California Oregon Power Company, San Francisco, has applied for permission to construct a hydro-electric plant on the Rogue River with initial capacity of 21,000 hp., to cost about $2,000,000, including transmission system.

ANAHEIM, CAL.—The City Council is considering the installation of an ornamental lighting system on North Los Angeles Street.

LODI, CAL.—The City Trustees have authorized John A. Henning, superintendent of the municipal electric plant, to install a distribution system for electricity and gas in the newly annexed addition to the city.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental lighting system on portions of Arden and Brooklyn Avenues.

OROVILLE, CAL.—The Pacific Gas & Electric Company has approved an appropriation of $40,000 for extensions and improvements in the local lighting system.

PASADENA, CAL.—The installation of ornamental lamps on Park View Drive, Banyan Street, Lewis and Laurel Streets, is under consideration.

REDDING, CAL.—The Board of Trustees is considering the installation of an ornamental lighting system on California Street.

SACRAMENTO, CAL.—The City Council has authorized plans for the installation of an ornamental lighting system on Thirty-seventh Street and adjoining thoroughfares.

SAN LUIS OBISPO, CAL.—The Midland Counties Public Service Corporation plans extensions to its system to cost $300,000, of which about $100,000 will be used for substations and improvements and $200,000 for additional transmission lines.

SANTA BARBARA, CAL.—The installation of an ornamental lighting system on Carillo Street from De La Vina to Canal Street is under consideration.

SEAL BEACH, CAL.—The Los Angeles Gas & Electric Company has acquired a site on the Alamitos Bay inlet for a steam-driven electric generating plant, with ultimate capacity of 285,000 hp.

PEACH SPRINGS, ARIZ.—Work has started by the Colorado River Engineering & Development Company on the construction of the Diamond Creek Dam, 21 miles north of here. The initial unit will develop 200,000 hp. James B. Girard, Phoenix, is engineer.

DENVER, COL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 15 for counterweights on mail lifts and incidental structural changes in the United States Post Office, Denver. For details see Searchlight Section.

Canada

CAMROSE, ALTA.—The Town Council is considering the installation of an additional unit in the municipal plant, to cost from $20,000 to $25,000.

CAMPBELLTON, N. B.—The ratepayers have approved a bylaw providing for a power development at Great Falls on the Upsalquitch River (21 miles from Campbellton), to cost about $420,000.

ST. JOHN, N. B.—Extension of the lines of the New Brunswick Electric Power Commission to serve the north end of the city is under consideration.

WOLFVILLE, N. S.—Plans to build an electric plant here are under consideration by J. A. Joudrey.

TORONTO, ONT.—The City Council has passed a by-law appropriating $1,940,000 for extentions and improvements to the municipal hydro-electric system.

BEDFORD, QUE.—The Council is considering a proposal submitted by the Southern Canada Power Company, Montreal, to extend its transmission line from Iberville to Bedford.

ST. DONAT, QUE.—Terando Contu, it is reported, contemplates a power development, and is in the market for a generator.

STE. MARTINE, QUE.—James Gordon Dunn, Jr., Huntington, is planning to build a power plant here, to develop about 300 hp.

Electrical Patents

Announced by U. S. Patent Office

(Issued Jan. 1, 1924)

1,479,387. METHOD FOR THE PRODUCTION OF MANGANESE STEEL; R. D. Jordan and J. H. Hall, High Bridge, N. J. App. filed June 5, 1922. By electric furnace.

1,479,388. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; A. A. Kent, Rosemont, and W. A. Evans, Fort Washington, Pa. App. filed July 27, 1917.

1,479,420. DECORATIVE LIGHTING; H. J. Nenno, Rochester, N. Y. App. filed Nov. 20, 1923. Series-connected lamps for Christmas-tree lighting.

1,479,429. REGULATION OF ELECTRIC FURNACES; W. Dryssen, New York, N. Y. App. filed Jan. 12, 1921. Automatic carriage device for electrodes.

1,479,430. TELEGRAPH REPEATER SYSTEM; J. M. Fell, Hackensack, N. J. App. filed March 26, 1921. Polar relays substituted for mutual relays in single telegraphy system.

1,479,432. BATTERY-CHARGING SYSTEM; C. F. Kettering, Dayton, Ohio. App. filed Feb. 11, 1918. Engine-driven generator automatically controlled by condition of battery.

1,479,442. METERING TELEPHONE SYSTEM; F. Aldendorff, Wilmersdorf, Berlin, Germany. App. filed June 21, 1920. For automatic or semi-automatic switching systems.

1,479,463. ELECTRIC BRAKE; J. B. Entz, New York, N. Y. App. filed Nov. 5, 1920. For gas-engine generator-motor equipment on vehicle.

1,479,465. CONTROL OF ELECTRIC CIRCUITS; T. T. Greenwood, East Templeton, Mass. App. filed Jan. 19, 1918. High-capacity oil-circuit-breaker mechanism.

1,479,475. RADIO RECEIVING APPARATUS; O. Minton, Greenwich, Conn. App. filed Jan. 19, 1923. Antenna replaced by grounded variable inductance and variable condenser.

1,479,486. ELECTRIC CLIPPER; L. J. Wahl, Sterling, Ill. App. filed Oct. 14, 1919. Hair clipper magnetically operated.

1,479,494. COMBINED ELECTRIC FAN AND HEATER; M. Beck, Minneapolis, Minn. App. filed Dec. 10, 1920. Heating elements carried by fan blades.

1,479,500. INSTALLATION FOR REGULATING AN ELECTRIC CURRENT NETWORK SUPPLIED WITH CURRENT FROM A GENERATOR RUNNING AT VARIABLE SPEED; J. Geisslinger, Carouge, Switzerland. App. filed Oct. 4, 1922. Railway car lighting apparatus.

1,479,505. TRANSMISSION CIRCUITS; K. S. Johnson, Jersey City, N. J. App. filed Jan. 16, 1920. Method of loading three-wire telephone circuit.

1,479,516. SIGNALING BY HIGH-FREQUENCY WAVES; E. O. Scriven, New York, N. Y. App. filed Sept. 29, 1919. Modulating arrangement for multiplex transmission.

1,479,519. SHORT-CIRCUITING DEVICE FOR ELECTRIC MOTORS; J. C. Steiner, St. Louis, Mo. App. filed June 3, 1921. For repulsion-induction-type motor.

1,479,524. GALVANOMETER; W. Van Guilder, Chicago, Ill. App. filed Aug. 26, 1921. Meter for indicating depth of liquid in a tank.

1,479,527. BATTERY ELECTRODE; H. D. Wilson, Indianapolis, Ind. App. filed March 20, 1923. Storage battery.

1,479,553. TROLLEY POLE; M. Parlow, Coello, Ill. App. filed June 8, 1923. For electric cars employed in mines.

1,479,554. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; L. Polinkowsky, New York, N. Y. App. filed Feb. 24, 1919. Full automatic type.

1,479,555. TELEPHONE SYSTEM; E. F. Potter, Glencoe, Ill. App. filed Jan. 26, 1921. Ringing system for automatic equipment.

1,479,561. REGULATING MEANS FOR DIRECT-CURRENT CIRCUITS; E. R. Stoekle, Milwaukee, Wis. App. filed June 18, 1920. Reactor on alternating-current side of rectifier automatically maintains constant direct-current voltage.

1,479,582. INDUCTION FURNACE; C. A. Brayton, Jr., Cleveland, Ohio. App. filed Sept. 24, 1920. Construction of refractory elements.

1,479,586. TELEPHONE SYSTEM; H. D. Currier, Chicago, Ill. App. filed Oct. 5, 1918. Intercommunicating system for about 200 telephones.

1,479,592. FLASHLIGHT; F. Evans, Summit, N. J. App. filed March 22, 1920. Self-contained generator.

1,479,597. SMOOTHING IRON FOR ASPHALT ROADS; C. A. Foust, Glendale, N. Y. App. filed Dec. 21, 1921. Electrically heated.

1,479,608. ATTACHMENT FOR SIGNAL BOXES; G. A. Jackson, Waltham, Mass. App. filed Dec. 27, 1922. Fire-alarm box.

1,479,613. MULTIPLEX SIGNALING; B. W. Kendall, New York, N. Y. App. filed July 19, 1917. Messages transmitted as modulations of carrier wave.

1,479,615. MULTIVOLTAGE SYSTEM OF CONTROL FOR ELEVATORS; G. W. Lautrup, Yonkers, N. Y. App. filed April 1, 1920.

1,479,617. TELEPHONE-EXCHANGE SYSTEM; J. L. McQuarrie and C. L. Goodrum, New York, N. Y. App. filed Dec. 4, 1919. Line switch employed in machine switching.

1,479,621. MAGNETIC TYPEWRITING MACHINE; W. F. Nichols, Munfordville, Ky. App. filed Sept. 5, 1922.

1,479,636. DYNAMO-ELECTRIC MACHINE; J. B. Wiard, Lynn, Mass. App. filed Sept. 15, 1919. Arrangement of ventilating ducts for induction motor.

1,479,638. MULTIPLE REGENERATIVE LOOP ANTENNA AND CIRCUIT; V. K. Zworykin, Kansas City, Mo. App. filed Aug. 28, 1922.

1,479,662. SMELTING ORES OF LOW-VOLATILE METALS AND MELTING SUCH METALS; J. H. Gray, New York, N. Y. App. filed Feb. 17, 1921. In electric furnace.

1,479,663. RELAY AND THE LIKE; A. Herz, Chicago, Ill. App. filed Feb. 16, 1920. Mercury relay.

1,479,664. SPEED-REGULATING SYSTEM FOR ELECTRIC MOTORS; W. T. Holmes, Baltimore, Md. App. filed Aug. 29, 1922. Remote-control apparatus.

1,479,669. INSULATOR PROTECTOR; J. E. McClain, Greenville, Tex. App. filed March 4, 1920. Cast-iron shell around lower part of insulator.

1,479,688. TELEGRAPH TRANSMITTER; F. W. Wright, Venezia, Ariz. App. filed Feb. 6, 1922. Automatic transmitters for teaching telegraphy.

1,479,692. ARC GAP; C. E. Bennett, Atlanta, Ga. App. filed May 25, 1920. For protective apparatus.

1,479,693. ARC GAP; C. E. Bennett, Atlanta, Ga. App. filed Aug. 10, 1920. For protective apparatus.

1,479,698. SHUNT COIL FOR ELECTRIC METERS; J. Choppinet, Brussels, Belgium. App. filed July 15, 1921. Construction details for induction-type meters.

1,479,718. ELECTRIC DRILL; F. W. Hewitt, Arlington, Mass. App. filed Oct. 27, 1921. Two heating elements.

1,479,725. ELECTRIC FLUID STERILIZER; B. W. Macy, Jacksonville, Fla. App. filed Feb. 2, 1922. For pasteurizing milk.

1,479,729. IRON; H. L. Mitchell and J. W. Slate, Walnut Cove, N. C. App. filed June 2, 1922. Circuit broken when handle is released.

1,479,759. MAGNETO-ELECTRIC MACHINE; G. M. Turner, South Kensington, London, England. App. filed July 19, 1920. Used with internal-combustion motors.

1,479,778. VACUUM-TUBE DEVICE; H. J. Van der Bijl, New York, N. Y. App. filed Sept. 30, 1918. Method of element mounting.

1,479,779. ELECTRON DISCHARGE DEVICE; H. J. Van der Bijl, New York, N. Y. App. filed July 20, 1920. Four-element type.

(Issued Jan. 8, 1924)

1,479,808. MEANS FOR STARTING INTERNAL-COMBUSTION ENGINES; C. H. D. Hayward, Newark, N. J. App. filed April 21, 1919. Engine of automobile fire apparatus started by auxiliary equipment connected to fire-alarm system.

1,479,836. ELECTRIC MOTOR CONTROL; B. D. Saklatwalla and A. N. Anderson, Crafton, Pa. App. filed April 24, 1919. Equipment for automatic regulation of electric furnace electrodes.

1,479,845. PRINTING-TELEGRAPH SYSTEM; G. S. Vernam, Brooklyn, N. Y. App. filed June 10, 1918. Synchronized distributors at sending and receiving station.

1,479,846. CIPHERING DEVICE; G. S. Vername, Brooklyn, N. Y. App. filed June 23, 1920. Apparatus for coding and decoding telegraph messages.

1,479,848. STORAGE BATTERY; H. M. Williams, Providence, R. I. App. filed Oct. 15, 1919. Solid electrolyte type.

1,479,910 SAFETY DEVICE FOR IGNITION MECHANISM; C. B. Hardman, Columbus, Ohio. App. filed Oct. 26, 1922.

1,479,951. ELECTRIC OVEN FOR DENTAL PURPOSES; W. A. Bjornstad and R. A. Silene, Minneapolis, Minn. App. filed Sept. 15, 1922. For burning out or melting wax models.

1,479,984. TELEPHONE-EXCHANGE SYSTEM; G. Deakin, Antwerp, Belgium. App. filed May 26, 1919. Automatic selective switches.

1,479,991. ELECTRON DISCHARGE DEVICE; R. W. King, New York, N. Y. App. filed Aug. 13, 1919. Method of holding elements using very little glass.

1,480,007. CONNECTING PLUG; L. G. Pacent, Winfield, N. Y. App. filed March 20, 1923. Telephone jack.

1,480,011. ELECTRIC GASLIGHTER; J. H. Roden, Toronto, Ontario, Canada. App. filed Dec. 1, 1922. Small transformer with heating element for lighting gas burners.

1,480,020. GUARD; C. F. Smith and A. A. Warner, New Britain, Conn. App. filed Feb. 14, 1921. Wire guard for placing over electric heaters of reflector type.

1,480,022. ELECTRIC WELDING APPARATUS; H. E. Snodgrass, Summit, N. J. App. filed May 6, 1920. Apparatus for welding seamed tubing.

1,480,059. METALLURGICAL PROCESS; W. E. Greenawalt, Denver, Col. App. filed April 16, 1918. Extraction of copper from ore by electrolysis.

1,480,064. ELECTRIC DEHYDRATOR; F. W. Harris, Los Angeles, Cal. App. filed Nov. 23, 1921. For handling very wet emulsions.

1,480,072. SEPARABLE ATTACHMENT PLUG; H. Hubbell, Bridgeport, Conn. App. filed Feb. 16, 1921. Screw plug for electric socket.

1,480,084. ELECTRIC TOASTER; J. F. Lamb, New Britain, Conn. App. filed Sept. 21, 1922. Special method of winding resistor element.

1,480,164. IGNITION EQUIPMENT; W. W. Hawkins, Brooklyn, N. Y. App. filed Feb. 20, 1922.

1,480,171. LANTERN; E. J. McDade, Warsaw, N. Y. App. filed Aug. 24, 1922. Standard dry cells used.

1,480,174. ELECTRIC WATER HEATER; F. E. Matthews, Bridgeport, Conn. App. filed Oct. 31, 1921. Automatic switch operated by flow of water.

1,480,189. ELECTRIC LIGHT FIXTURE; W. E. Walsh, Winthrop, and H. C. Jones, Watertown, Mass. App. filed March 17, 1922. Method of diffusing light.

1,480,202. TELEPHONE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed Dec. 17, 1919. All switching operations made by relays.

1,480,206. MACHINE SWITCHING TELEPHONE-EXCHANGE SYSTEM; H. L. Hoffmann, New York, N. Y. App. filed Dec. 24, 1920. Means for collecting money on toll lines.

1,480,208. VACUUM TUBE; W. G. Housekeeper, New York, N. Y. App. filed April 15, 1921. Method of supporting elements.

1,480,209. CARRIER-WAVE CALL-SIGNALING SYSTEM; J. S. Jammer, New York, N. Y. App. filed Dec. 29, 1920. Closed-circuit system with means for preventing actuation of apparatus when power fails.

1,480,210. TELEPHONE CIRCUITS AND METHOD OF OPERATING THE SAME; K. S. Johnson, Jersey City, N. J. App. filed Sept. 5, 1919. Two-element transmitter.

1,480,214. TELEPHONE-EXCHANGE SYSTEM; A. E. Lundell, New York, N. Y. App. filed Nov. 6, 1920. Manually operated exchange.

1,480,215. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; W. H. Matthies, Hackensack, N. J. App. filed Feb. 24, 1919. Full automatic type.

1,480,216. TRANSMISSION SYSTEM; J. Mills, Wyoming, N. J. App. filed Oct. 11, 1916. Combined telephone line and radio transmitting system.

1,480,217. METHOD AND MEANS FOR SIGNALING; J. Mills, Wyoming, N. J. App. filed Dec. 29, 1916. Method of sending and receiving coded messages.

1,480,219. VACUUM TUBE; A. McL. Nicolson, New York, N. Y. App. filed June 25, 1917. Special form and space relation of electrodes.

1,480,227. IMPEDANCE ELEMENT; G. H. Stevenson, Rye, N. Y. App. filed May 16, 1921. For high-frequency alternating currents.

1,480,229. TELEPHONE-EXCHANGE SYSTEM; W. B. Strickler, East Orange, N. J. App. filed Oct. 15, 1920. Manual private-branch exchange connected to automatic exchange.

1,480,235. CARRIER-WAVE SIGNALING SYSTEM; C. White, East Orange, N. J. App. filed Dec. 21, 1920. Call signaling system wherein device is actuated only when the carrier is removed from the transmission medium.

1,480,240. TELEPHONE-EXCHANGE SYSTEM; E. H. Clark, Richmond Hill, N. Y. App. filed April 22, 1920. Employs automatic switching apparatus.

1,480,241. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; H. P. Clausen, Mount Vernon, and C. L. Goodrum, New York, N. Y. App. filed July 16, 1918. Special signal for calling a person anywhere in building.